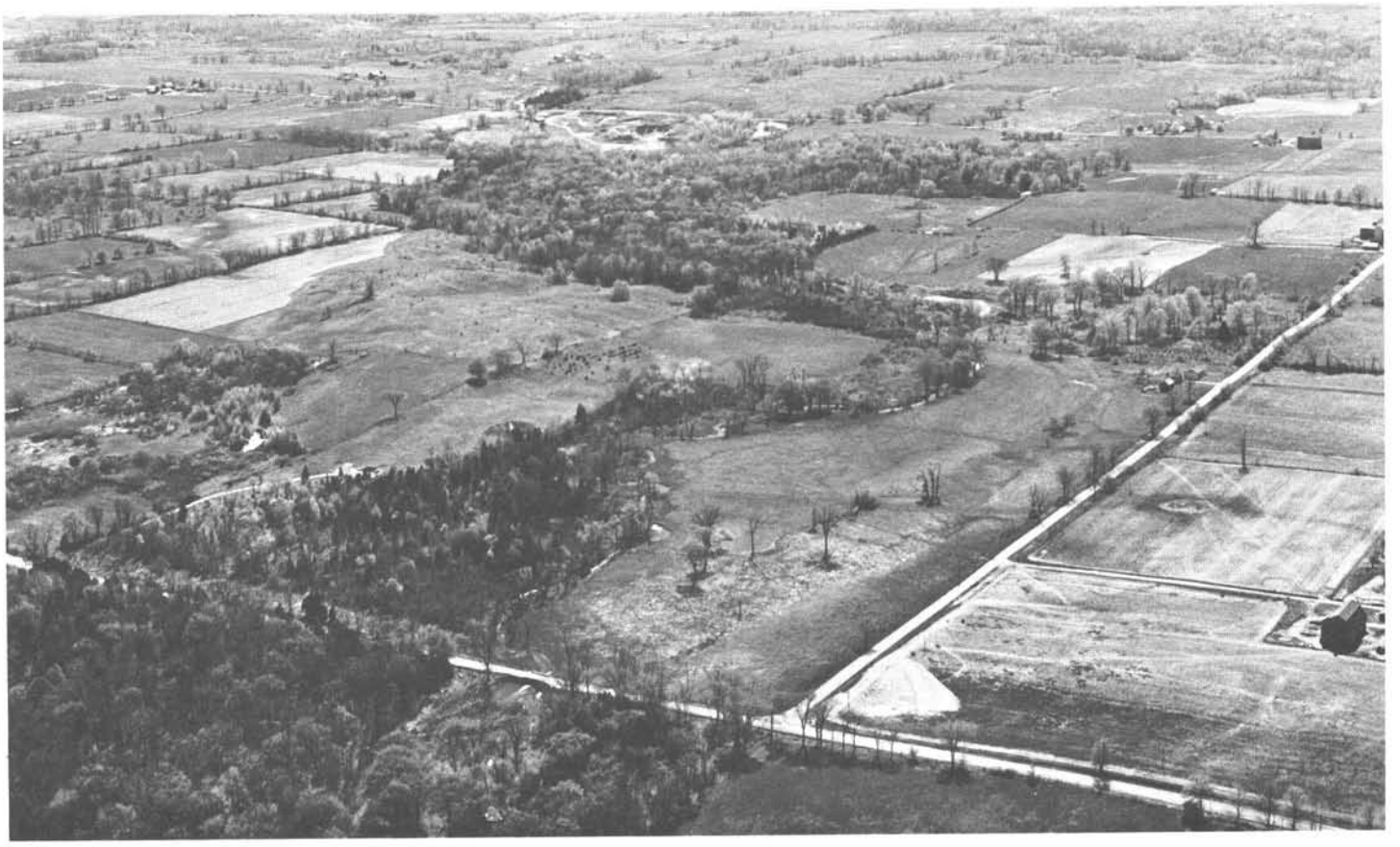
SOIL SURVEY OF

Lapeer County, Michigan



United States Department of Agriculture
Soil Conservation Service
In cooperation with
Michigan Agricultural Experiment Station

Issued January 1972

Major fieldwork for this soil survey was done in the period 1954–62. Soil names and descriptions were approved in 1966. Unless otherwise indicated, statements in this publication refer to conditions in the county in1962. This survey was made cooperatively by the Soil Conservation Service and the Michigan Agricultural Experiment Station. It is part of the technical assistance furnished to the Lapeer County Soil Conservation District.

Either enlarged or reduced copies of the soil map in this publication can be made by commercial photographers, or they can be purchased on individual order from the Cartographic Division, Soil Conservation Service, USDA, Washington, D.C. 20250.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY contains information that can be applied in managing farms and woodlands; in selecting sites for roads, ponds, buildings, and other structures; and in judging the suitability of tracts of land for farming, industry, and recreation.

Locating Soils

All the soils of Lapeer County are shown on the detailed map at the back of this publication. This map consists of many sheets made from aerial photographs. Each sheet is numbered to correspond with a number on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by symbols. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

Finding and Using Information

The "Guide to Mapping Units" can be used to find information. This guide lists all the soils of the county in alphabetical order by map symbol and gives the capability classification and woodland suitability classification of each. It also shows the page where each soil is described and the page where the capability unit and the woodland suitability group are described.

Individual colored maps showing the relative suitability or degree of limitation of soils for many specific purposes can be developed by using the soil map and the information in the text. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same degree of limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

Farmers and those who work with farmers can learn about use and management of the soils from the soil descriptions and from the discussions of the capability units and woodland suitability groups.

Foresters and others can refer to the section "Woodland," where the soils of the county are grouped according to their suitability for trees.

Game managers, sportsmen, and others can find information about soils and wildlife habitat in the section "Wildlife."

Community planners and others can find, in the section "Soil Properties that Affect Community Development," information significant in the choice of sites for building, for recreation, and for other uses related to community development.

Engineers and builders can find, under the heading "Engineering Uses of the Soils," tables that contain test data, estimates of soil properties, and interpretations of these soil properties as they affect engineering practices.

Scientists and others can read about how the soils formed and how they are classified in the section "Formation and Classification of the Soils."

Newcomers to the county may be especially interested in the section "General Soil Map," where broad patterns of soils are described, and in the general information about the county given at the beginning and end of the publication.

Cover picture

Typical area in the Lapeer-Miami-Celina soil association (association 9). Cropland is predominant, but small woodlots are common.

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SOIL SURVEY OF LAPEER COUNTY, MICHIGAN

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UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, IN COOPERATION WITH THE MICHIGAN AGRICULTURAL EXPERIMENT STATION

LAPEER COUNTY is in the southeastern part of Michigan (fig. 1), in what is commonly called the Thumb Area of the State. The county is located within 50 miles of the metropolitan areas of Detroit, Flint, and Saginaw. The city of Lapeer is the county seat and the main commercial center for the county. The total area of Lapeer County is 421,760 acres, or about 659 square miles. In 1960, nearly 42,000 people lived in the county. The climate is favorable for the growth of most crops of the area, and farming, mainly dairy farming, is still the principal industry. Small industries are located throughout the county. Many residents of the county are employed outside the county by the automobile industry.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in Lapeer County, where they are located, and how they can be used. The soil scientists went into the county knowing they likely would find many soils they had already seen and perhaps some they had not. As they traveled over the county, they observed the steepness, length, and shape of slopes, the size and speed of streams, the kinds of native plants or crops, the kinds of rock, and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by the action of plant roots.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. The *soil series* and the *soil phase* are the categories of soil classification most used in a local survey.

Soils that have profiles almost alike make up a series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Abscota and Boyer, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

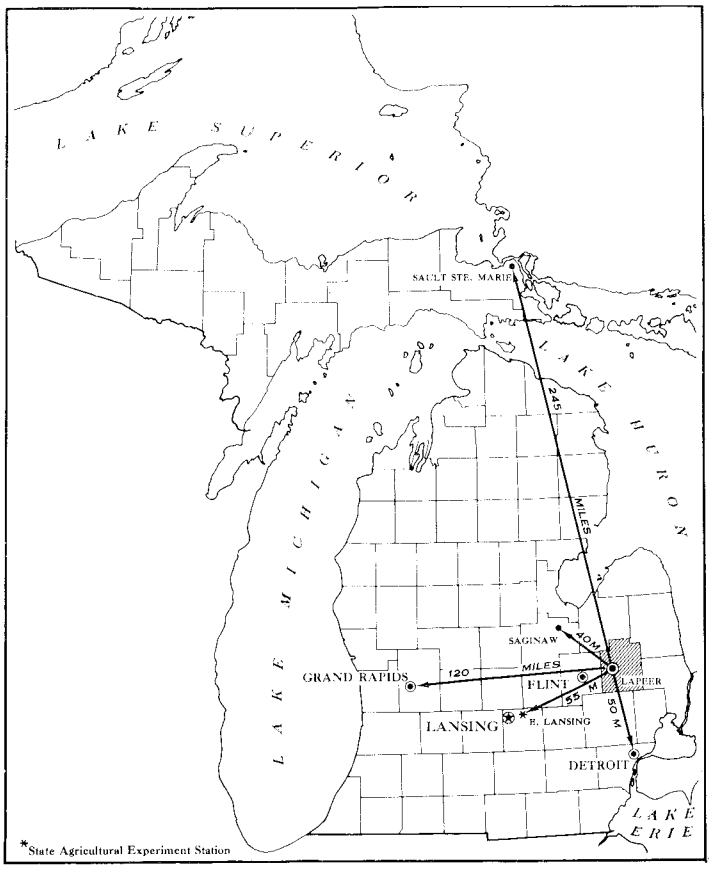

Figure 1.—Location of Lapeer County in Michigan.

Soils of one series can differ in texture of the surface soil and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such

differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Boyer loamy sand, 0 to 2 percent slopes, is one of several phases within the Boyer series.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show woodlands, buildings, field borders, trees, and other details that help in drawing boundaries accurately. The soil map in the back of this publication was prepared from aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning the management of farms and fields, a mapping unit is nearly equivalent to a soil phase. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly of a recognized soil phase.

Some mapping units are made up of soils of different series, or of different phases within one series. One such kind of mapping unit, the soil complex, is shown on the soil map of Lapeer County.

A soil complex consists of areas of two or more soils, so intricately mixed or so small in size that they cannot be shown separately at the scale used for the soil map. Each area of a complex contains some of each of the two or more dominant soils, and the pattern and relative proportions are about the same in all areas. The name of a soil complex consists of the names of the dominant soils, joined by a hyphen. Fabius-Wasepi sandy loams, 0 to 2 percent slopes, is an example.

In most areas surveyed there are places where the soil material is so rocky, so shallow, or so severely eroded that it cannot be classified by soil series. These places are shown on the soil map and are described in the survey, but they are called land types and are given descriptive names. Gullied land, sandy, is a land type in Lapeer County.

While a soil survey is in progress, samples of soils are taken, as needed, for laboratory measurements and for engineering tests. Laboratory data from the same kinds of soil in other places are assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soil. Yields under defined management are estimated for all the soils.

But only part of a soil survey is done when the soils have been named, described, and delineated on the map, and the laboratory data and yield data have been assembled. The mass of detailed information then needs to be organized in such a way as to be readily useful to different groups of users, among them farmers, managers of woodland and rangeland, and engineers.

On the basis of yield and practice tables and other data, the soil scientists set up trial groups. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others, then adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under present methods of use and management.

General Soil Map

The general soil map at the back of this survey shows, in color, the soil associations in Lapeer County. A soil association is a landscape that has a distinctive, proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the soils in a county, or who want to compare different parts of a county, or who want to know the location of large tracts that are suitable for a certain kind of farming or other land use. Such a map is not suitable for planning management of a farm or field, because, ordinarily, the soils within any given association differ in slope, depth, stoniness, drainage, and other characteristics that affect management.

The 12 soil associations in Lapeer County are discussed in the following pages. More detailed information about the soils is given in the section "Descriptions of the Soils."

1. Roselms-Paulding association

Level to undulating, somewhat poorly drained to very poorly drained soils that have a clay subsoil; on lake plains

This association is in the northern part of the county, in the vicinity of Silverwood. It covers about 3 percent of the county.

The Roselms and Paulding soils are dominant. The Roselms soils make up about 25 percent of the acreage, and the Paulding soils 20 percent. Minor soils, mainly Willette, Munuscong, and Belding, clay subsoil variant, make up 55 percent.

The Roselms soils are on the slightly higher parts of the undulating landscape, and the Paulding soils are in the swales and in broader, slightly depressed areas (fig. 2). The soils of both these series are excessively wet, but the Roselms soils have better surface drainage and internal drainage than the Paulding soils. The Willette and Munuscong soils occur in depressions scattered throughout the association, and the Belding soils occupy scattered positions at the slightly higher elevations.

Most of this association is farmed, in spite of severe limitations. The soils are clayey, have poor tilth, are excessively wet, and are difficult to drain artificially. They dry out slowly in spring and after rain in other seasons. Planting and harvesting are difficult because farm machinery is likely to bog down. The water table is at or near the surface unless lowered by artificial drainage. Generally there is no erosion hazard.

The limitations for recreational and residential uses are severe. The high water table and the clayey texture of the soils hinder the construction of houses and streets and the installation of utilities. Highways heave and crack as a result of volume changes that take place as the moisture content changes.

Figure 2.—**Typical area in the Roselms-Paulding association. Dark-colored Paulding soils in the low areas, and Roselms soils in the higher areas.**

2. *Carlisle-Lupton-Tawas association*

Level, very poorly drained, peat and muck soils; on plains and in depressions

This association is in the eastern part of the county. The largest area extends from Almont to North Branch and is a quarter of a mile to a mile and a half wide. The total area of this association is about 3 percent of the county.

The Carlisle, Lupton, and Tawas soils are dominant. The Carlisle soils make up about 55 percent of the acreage, the Lupton soils 20 percent, the Tawas soils 15 percent, and minor soils, mainly Edwards, Spalding, and Greenwood, about 10 percent.

In the Carlisle and Lupton soils, organic material extends to a depth of 42 inches or more; in the Tawas soils, organic material extends to a depth of 12 to 42 inches and is underlain with sand. The Edwards soils consist of 12 to 42 inches of muck over marl. The Spalding and Greenwood soils, which are near the St. Clair County line, consist of 42 inches or more of acid peat.

Large areas of this association have been cleared and drained and are now cultivated intensively for vegetables and lawn sod. The major limitations are a high water table, low fertility, and hazards of frost, soil blowing, and fire. Controlled artificial drainage is needed to make intensive cropping practical. Specialized fertilization programs are necessary because of micronutrient deficiencies. Soil blowing and fire can cause serious losses. Buffer strips, windbreaks, irrigation, and compaction of the surface are among the means used to control erosion (fig. 3).

The limitations for residential and recreational uses are very severe. The high water table and the instability of the organic soil material hinder the construction of houses and streets and the installation of utilities.

3. *Chelsea-Sloan-Cohoctah association*

Level to undulating, well-drained soils that have a sand and loamy sand subsoil, on outwash plains; and level, poorly drained soils that have a silt loam to fine sandy loam subsoil, on flood plains

This association is in the northwestern part of the county. It consists of flood plains and outwash plains on either side of the Flint River. The flood plains are an eighth of a mile to three quarters of a mile wide. The river has cut into the sandy outwash plains to a depth of 20 to 30 feet and left a series of steep escarpments along the outer edges of the flood plains. The total area of this association is about 3 percent of the county.

The Chelsea, Sloan, and Cohoctah soils are dominant. The Chelsea soils make up about 50 percent of the acreage, the Sloan soils 20 percent, the Cohoctah soils 10 percent, and minor soils, mainly Oshtemo, Granby, Glendora, and Tawas, the remaining 20 percent.

Figure 3.—Typical area in the Carlisle-Lupton-Tawas association. Windbreaks for control of erosion and open ditches for drainage are typical of this association.

The sandy, well-drained Chelsea soils are on the outwash plains; the poorly drained Sloan and Cohoctah soils are on the flood plains, which are characterized by numerous depressions and abandoned river channels. Of the minor soils, the well-drained Oshtemo soils are on the outwash plains, the poorly drained Granby soils are in depressions on the outwash plains, and the poorly drained Glendora soils and the very poorly drained Tawas soils are on the flood plains.

Most of the acreage of the Chelsea soils has been farmed in the past, and some still is. Fence rows made of old pine stumps are evidence that these terraces were once covered with pine. Many areas have been reforested, and some areas are idle. Low available water capacity and low fertility are the major limitations for farming.

The Sloan and Cohoctah soils are mainly in woods. Excessive wetness, flooding in spring and after rain in other seasons, and dissection by meandering streams limit the use of these soils for crops. Some areas are used for recreation, and some are idle.

The limitations of the Chelsea soils for residential and recreational uses are no more than slight. These sandy soils make good foundations for houses, streets, and highways. For the Sloan and Cohoctah soils, periodic flooding constitutes a severe limitation.

4. Capac-Belding-Brookston association

Level to gently sloping, somewhat poorly drained and poorly drained soils that have a sandy loam to clay loam subsoil; on till plains

Most of this association is in the northeastern part of the county. Although the relief is mainly level to gently sloping, there are steeper slopes next to the major drainageways. The total area is about 11 percent of the county.

The Capac, Belding, and Brookston soils are dominant. The Capac soils make up about 40 percent of the acreage, the Belding soils 20 percent, and the Brookston soils 15 percent. Minor soils, mainly well-drained Marlette and Menominee soils but including poorly drained Breckenridge and very poorly drained Lupton soils, make up the remaining 25 percent.

The Belding soils are at slightly higher elevations than the Capac soils. The Brookston soils are in drainageways and other slightly depressed locations.

The soils in this association are well suited to crops, and most of the acreage is intensively farmed. Poor drainage is the main limitation; the Brookston soils are the most seriously limited. Water ponds in low places and hinders farming operations in spring and after rain in other seasons. Some areas lack outlets that can be used for artificial drainage. In low areas, early frost is a hazard to crops.

Most areas of this association have severe limitations for residential and recreational uses. A high water table and poor surface drainage make it difficult to build houses and streets and to install utilities. Frost heave is a hazard to highways.

5. *Capac-Blount-Kibbie association*

Level to gently sloping, somewhat poorly drained soils that have a dominantly clay loam to silt loam subsoil; on till plains, outwash plains, and lake plains

The larger part of this association is in the northwestern part of the county, north of the Flint River. A smaller area is located in the northeastern part. Though the relief is mainly level to gently sloping, there are steeper slopes next to the major drainageways and several small hilly areas next to the Tuscola County line. The total area is about 8 percent of the county.

The Capac, Blount, and Kibbie soils are dominant. The Capac soils make up about 30 percent of the acreage, the Blount soils 25 percent, the Kibbie soils 15 percent, and minor soils, mainly Pewamo and Brookston, the remaining 30 percent.

The Capac soils are at slightly higher elevations than the Blount soils and have a more undulating relief. The Kibbie soils are level.

The soils of this association are well suited to crops, and most of the acreage is intensively farmed (fig. 4). Small woodlots are scattered throughout the association. Excessive wetness and poor tilth are the main limitations for farming. Many areas have been drained artificially, but some areas have inadequate outlets and some have no outlets.

The limitations for residential and recreational uses are generally severe. Excessive wetness and slow runoff make it difficult to build houses and streets and to install utilities.

6. *Conover-Blount-Brookston association*

Level to gently sloping, somewhat poorly drained and poorly drained soils that have a dominantly clay loam subsoil; on till plains

This association is in the southeastern quarter of the county. The landscape is one of gently undulating slopes broken by broad, shallow drainageways and depressions. The total area is about 9 percent of the county.

The Conover, Blount, and Brookston soils are dominant. The Conover soils make up about 55 percent of the acreage, the Blount soils 15 percent, the Brookston soils 10 percent, and minor soils, mainly Kibbie, Locke, Nappanee, and Hoytville, the remaining 20 percent.

The Brookston soils are in the drainageways and depressions, and the Conover and Blount soils are at the slightly higher elevations. Small areas of the Kibbie and Locke soils occur throughout the association. Scattered areas of the Nappanee and Hoytville soils, totaling several thousand acres, occur north of the Belle River, near Imlay City.

The soils of this association are well suited to crops, and most of the acreage is farmed. Excessive wetness is the main limitation. Many areas have been drained artificially, but some areas have inadequate outlets and some have no outlets. Some of the areas not drained are still in woods. Early frost is a hazard to crops in low spots.

The limitations for residential and recreational uses are severe. Excessive wetness and slow runoff make it difficult to build houses and streets and to install utilities. Frost heave and wetness cause highways to break up.

7. *Fabius-Wasepi-Mussey-Gilford association*

Level to gently sloping, somewhat poorly drained and poorly drained soils that have a sandy loam to gravelly clay loam subsoil; on outwash plains and lake plains

This association occurs along Cedar Creek and just east of the city of Lapeer. It also occurs along Peters Drain, Weaver Drain, and Columbus Drain, all of which are among the streams that form the headwaters of the Cass River. The level to gently undulating landscape is broken with a few large depressions. The total area is about 2 percent of the county.

The Fabius, Wasepi, Mussey, and Gilford soils are dominant. The Fabius and Wasepi soils, which are closely intermingled, together make up about 50 percent of the acreage, and the Mussey and Gilford soils, also closely intermingled, together make up 25 percent. Minor areas of the Tawas, Carlisle, Del Rey, Kibbie, Boyer, and Oshtemo soils make up the remaining 25 percent.

The Fabius and Wasepi soils formed in water-deposited loamy sand and sandy loam underlain with sand and gravel. The Mussey and Gilford soils are on the lower parts of the landscape. The minor soils are scattered. Depressions near Cedar Creek are occupied by the Tawas and Carlisle soils. On the lake plain around the city of Lapeer are large areas of the somewhat poorly drained Del Rey and Kibbie soils; these soils formed in lacustrine silt, fine sand, and silty clay loam and are finer textured than the dominant soils of the association. The well-drained Boyer and Oshtemo soils are on the highest parts of the landscape.

Although the soils are excessively wet and low in fertility, most of this association is farmed. Many areas are drained artificially, but some, including most of the areas of the Tawas and Carlisle soils, have inadequate outlets or no outlets. Fairly extensive areas of poorly drained soils that have not been drained artificially are in woods.

For the major part of this association, a high water table constitutes a severe limitation for residential and recreational uses. The minor Boyer and Oshtemo soils have no more than slight limitations for such uses.

Gravel and sand suitable for commercial use can be obtained from soils in this association. Gravel pits are common.

8. *McBride-Marlette association*

Gently sloping to strongly sloping, well drained and moderately well drained soils that have a sandy loam to clay loam subsoil; on till plains and moraines

This association is in the north-central part of the county, between Mill Creek and the sand plains along the Flint River. The landscape includes small hilly areas and steeper slopes next to major drainageways. The total area of this association is about 10 percent of the county.

The McBride and Marlette soils are dominant. The McBride soils make up about 35 percent of the acreage,

Figure 4.—**Typical area in the Capac-Blount-Kibbie association. Most of this association is intensively farmed.**

and the Marlette soils 35 percent. The minor soils that make up the remaining 30 percent are mainly of the Menominee, Belding, Locke, and Capac series but include also poorly drained Barry soils and very poorly drained Carlisle soils in depressions.

The McBride soils formed in sandy loam, and the Marlette soils in loam. The Marlette soils are concentrated east of the Bottom Creek outwash plain.

Most of this association is farmed. The erosion hazard is the main limitation for farming. Most farms include some soils that are too strongly sloping to be used for cultivated crops, and slope limits the use of farm machinery in many areas. Also, some of the minor soils are too wet to be suitable for crops. Many farms have small woodlots.

The limitations for residential and recreational uses are slight to severe, depending on the slope. The soil material makes good foundations for houses, streets, and highways, but construction on the strongly sloping soils is difficult.

9. Lapeer-Miami-Celina association

Gently sloping to strongly sloping, well drained and moderately well drained soils that have a dominantly loam to clay loam subsoil; on till plains and moraines

This association is in the southern half of the county. It extends from Almont northward past Imlay City and northwestward through Lapeer to Columbiaville. The landscape includes small hilly areas and steeper slopes next to the major drainageways. The total area of this association is about 20 percent of the county.

The Lapeer, Miami, and Celina soils are dominant. The Lapeer soils make up about 20 percent of the acreage, the Miami soils 15 percent, and the Celina soils 15 percent. The minor soils that make up the remaining 50 percent are mainly of the Sisson, Tuscola, and Locke series but include poorly drained Colwood and Sebewa soils in small depressions.

The Lapeer soils formed in sandy loam, and the Miami and Celina soils in loam.

The soils in this association are fairly well suited to crops. Most of the acreage is cultivated, but woodlots of less than 40 acres are common. The erosion hazard is the main limitation for farming. Most farms include soils that are too strongly sloping to be used for cultivated crops, and slope limits the use of farm machinery in many areas. Some of the minor soils are too wet to be suitable for crops.

The limitations for residential and recreational uses are slight to severe, depending on the slope. The soil material makes good foundations for houses, streets, and highways, but construction on the strongly sloping soils is difficult. Northwest of Lapeer are numerous small lakes, which give the area potential for recreational uses.

Figure 5.—Typical area in the Miami-Celina-Morley association. Because of the slope, erosion is prevalent.

10. Miami-Celina-Morley association

Gently sloping to strongly sloping, well drained and moderately well drained soils that have a clay loam and clay subsoil; on till plains and moraines

This association is in the southwestern corner of the county. The landscape, predominantly one of rounded landforms, includes small hilly areas, small depressions, and lakes. The total area of the association is about 9 percent of the county.

The Miami, Celina, and Morley soils are dominant. The Miami soils make up about 25 percent of the acreage, the Celina soils 20 percent, and the Morley soils 20 percent. The remaining 35 percent consists mainly of Blount soils, poorly drained Pewamo soils, and very poorly drained Houghton soils. The Pewamo and Houghton soils are in depressions.

The Miami, Celina, and Morley soils formed in loam, clay loam, and silty clay loam.

The hazard of erosion is the main limitation for farming (fig. 5). In many parts of the association, the slopes are too short and too irregular for contour farming, which would help to control erosion. Many of the strongly sloping areas that were cropped in the past are now idle, or are used for pasture or hay, or have been reforested. Woodlots less than 40 acres in size occur locally.

The limitations for residential and recreational uses are slight to severe, depending on the slope. The soils are fair to good as foundation material for houses, streets, and highways, but construction on the strongly sloping soils is difficult.

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11. Boyer-Montcalm-McBride association

Gently sloping to very steep, dominantly well-drained soils that have a loamy sand to sandy clay loam subsoil; on outwash plains, till plains, and moraines

This association occupies several areas in the northern half of the county. The gently sloping to very steep landscape (fig. 6) includes lakes and small depressions. The total area is about 12 percent of the county.

The Boyer, Montcalm, and McBride soils are dominant. The Boyer soils make up about 35 percent of the acreage, the Montcalm soils 15 percent, and the McBride soils 15 percent. The minor soils that make up the remaining 35 percent are mainly of the Wasepi and Ubly series but include poorly drained Gilford and very poorly drained Tawas soils.

The Boyer soils are underlain with sand and gravel. The Montcalm soils consist of loamy sand and sand, and the McBride soils of sandy loam and loam. The minor Wasepi soils are somewhat poorly drained, and the Ubly soils are well drained to moderately well drained.

The larger part of this association has severe limitations for farming. Many areas are too steep, too droughty, or too wet to be suitable for crops. The short, irregular slopes make it difficult to build terraces or to farm on the contour. Large acreages are in woods. Generally, only the least sloping areas are used for crops. Livestock and forage crops are the principal farm products. Other areas that were once used for crops are now reforesting naturally.

The limitations for residential and recreational uses are slight to severe, depending on the slope. The Boyer

Figure 6.—**Typical area in the Boyer-Montcalm-McBride association. Deansville Moraine in the background.**

soils are good foundation material for houses, streets, and highways, but construction is difficult where the slopes are steep.

The Boyer soils are sources of sand and gravel.

12. Boyer-Miami-Lapeer association

Gently sloping to very steep, well-drained soils that have a sandy loam to clay loam subsoil; on outwash plains, till plains, and moraines

This association is in the southern part of the county. The hilly landscape includes lakes and small depressions. The total area of the association is about 10 percent of the county.

The Boyer, Miami, and Lapeer soils are dominant. The Boyer soils make up about 25 percent of the acreage, the Miami soils 20 percent, and the Lapeer soils 15 percent. The minor soils that make up the remaining 40 percent are mainly of the Spinks series but include poorly drained Brookston and Gilford soils and the very poorly drained Carlisle soils in depressions.

The Boyer, Miami, and Lapeer soils all formed in glacial material. The Boyer soils are underlain with sand and gravel, the Miami soils with loam, and the Lapeer soils with sandy loam.

Large acreages in this association were once used for crops but are now idle, or are used for pasture or hay, or are reforesting naturally. Many areas are in woods. Cultivated crops are grown only on the least sloping parts. Livestock and forage crops are the principal farm products. The Boyer soils are droughty, and all the major soils are limited by an erosion hazard.

The limitations for residential and recreational uses are slight to severe, depending on the slope. The Boyer soils are good foundation material for houses, streets, and highways, but construction on the steep soils is difficult.

The Boyer soils are sources of sand and gravel.

Descriptions of the Soils

In this section the soil series and mapping units of Lapeer County are described. The acreage and the proportionate extent of each mapping unit are given in table 1.

The procedure is to describe first a soil series and then the mapping units in that series. Thus, to get full information on any given mapping unit, one needs to read the description of the series as well as the description of the mapping unit.

Each series description includes two descriptions of the same typical profile of a soil of the series. The first is a brief description, in paragraph form, which many readers will find gives as much information as they need. The second is a longer, more detailed description that soil

scientists, engineers, and others can use as a basis for technical interpretations.

As explained in the section "How This Survey Was Made," some mapping units are miscellaneous land types rather than soils of any given series. The Gullied land units are examples. Such mapping units are described in this section, along with the soil series and the soil units.

In parentheses following the name of each mapping unit is a symbol made up of capital and small letters and, in some cases, a figure. This symbol identifies the mapping unit on the detailed soil map, which is at the back of this publication. In parentheses at the end of each soil description are the symbols that identify the capability unit and the woodland suitability group in which the mapping unit has been placed. The "Guide to Mapping Units," at the back of this publication before the detailed soil map, gives the map symbols and names of all the mapping units, in alphabetical order, the number of the page on which each unit is described, the symbol for the capability unit and that for the woodland suitability group for each mapping unit, and the number of the page on which each of these groupings is described.

Technical terms used in describing the soils are defined in the Glossary.

TABLE 1.—*Approximate acreage and proportionate extent of soils*

Soil	Acres	Percent	Soil	Acres	Percent
Abscota loamy sand	174	(1)	Dryden sandy loam, 0 to 2 percent slopes	991	.2
Adrian muck	1,637	0.4	Dryden sandy loam, 2 to 6 percent slopes	2,088	.5
Alcona sandy loam, 0 to 2 percent slopes	391	.1	Edwards muck	5,963	1.4
Alcona sandy loam, 2 to 6 percent slopes	442	.1	Fabius-Wasepi sandy loams, 0 to 2 percent slopes	6,575	1.6
Alcona sandy loam, 6 to 12 percent slopes	101	(1)	Fabius-Wasepi sandy loams, 2 to 6 percent slopes	1,536	.4
Algansee sandy loam	581	.1	Fox sandy loam, 0 to 2 percent slopes	483	.1
Allendale loamy sand, 0 to 2 percent slopes	306	.1	Fox sandy loam, 2 to 6 percent slopes	1,654	.4
Allendale loamy sand, 2 to 6 percent slopes	234	.1	Fox sandy loam, 6 to 12 percent slopes, moderately eroded	844	.2
Au Gres loamy sand, 0 to 6 percent slopes	964	.2	Gilford sandy loam	1,140	.3
Au Gres loamy sand, loamy substratum, 0 to 2 percent slopes	171	(1)	Glendora loam	2,545	.6
Barry loam	950	.2	Granby loamy sand	2,806	.7
Belding sandy loam, 0 to 2 percent slopes	4,655	1.1	Granby loam	315	.1
Belding sandy loam, 2 to 6 percent slopes	2,909	.7	Gravel pits	735	.2
Belding sandy loam, clay subsoil variant, 0 to 2 percent slopes	612	.1	Gullied land, sandy	47	(1)
Belding sandy loam, clay subsoil variant, 2 to 6 percent slopes	407	.1	Gullied land, loamy	142	(1)
Berville loam	817	.2	Houghton muck	5,147	1.2
Blount loam, 0 to 2 percent slopes	7,506	1.8	Hoytville silt loam	811	.2
Blount loam, 2 to 6 percent slopes	6,775	1.6	Hoytville silty clay loam	1,907	.5
Blount loam, 2 to 6 percent slopes, moderately eroded	800	.2	Iosco loamy sand, 0 to 2 percent slopes	1,791	.4
Borrow pits	103	(1)	Kibbie loam, 0 to 2 percent slopes	5,954	1.2
Boyer loamy sand, 0 to 2 percent slopes	3,732	.9	Kibbie loam, 2 to 6 percent slopes	1,967	.5
Boyer loamy sand, 2 to 6 percent slopes	8,655	2.0	Lapeer sandy loam, 0 to 2 percent slopes	1,084	.3
Boyer loamy sand, 6 to 12 percent slopes	4,293	1.0	Lapeer sandy loam, 2 to 6 percent slopes	9,486	2.3
Boyer loamy sand, 12 to 18 percent slopes	3,405	.8	Lapeer sandy loam, 2 to 6 percent slopes, moderately eroded	2,166	.5
Boyer loamy sand, 18 to 25 percent slopes	2,222	.5	Lapeer sandy loam, 6 to 12 percent slopes	1,342	.3
Boyer loamy sand, 25 to 50 percent slopes	2,237	.5	Lapeer sandy loam, 6 to 12 percent slopes, moderately eroded	3,356	.8
Boyer sandy loam, 0 to 2 percent slopes	520	.1	Lapeer sandy loam, 6 to 12 percent slopes, severely eroded	380	.1
Boyer sandy loam, 2 to 6 percent slopes	2,339	.6	Lapeer sandy loam, 12 to 18 percent slopes, moderately eroded	1,377	.3
Boyer sandy loam, 6 to 12 percent slopes	1,333	.3	Lapeer sandy loam, 12 to 18 percent slopes, severely eroded	734	.2
Boyer sandy loam, 12 to 18 percent slopes	374	.1	Lapeer sandy loam, 18 to 25 percent slopes, moderately eroded	503	.1
Brady loamy sand, 0 to 2 percent slopes	1,338	.3	Lapeer sandy loam, 18 to 25 percent slopes, severely eroded	189	(1)
Brady loamy sand, 2 to 6 percent slopes	533	.1	Lapeer sandy loam, 25 to 60 percent slopes	477	.1
Breckenridge sandy loam	1,850	.4	Lenawee silty clay loam	907	.2
Brevort loamy sand	833	.2	Linwood muck	2,808	.7
Brookston loam	10,243	2.4	Locke sandy loam, 0 to 2 percent slopes	4,137	1.0
Capac fine sandy loam, 0 to 2 percent slopes	9,803	2.3	Locke sandy loam, 2 to 6 percent slopes	4,187	1.0
Capac fine sandy loam, 2 to 6 percent slopes	18,045	4.3	Lupton muck	5,194	1.2
Carlisle muck	17,205	4.1	Macomb sandy loam, 0 to 2 percent slopes	883	.2
Celina loam, 0 to 2 percent slopes	2,163	.5	Macomb sandy loam, 2 to 6 percent slopes	1,205	.3
Celina loam, 2 to 6 percent slopes	12,329	3.2	Made land	184	(1)
Celina loam, 2 to 6 percent slopes, moderately eroded	2,613	.6	Mancelona loamy sand, moderately fine substratum, 0 to 6 percent slopes	1,052	.2
Ceresco loam	554	.1	Mancelona loamy sand, moderately fine substratum, 6 to 12 percent slopes, moderately eroded	222	.1
Chelsea loamy sand, 0 to 6 percent slopes	8,244	2.0	Marlette sandy loam, 0 to 2 percent slopes	468	.1
Chelsea loamy sand, 6 to 12 percent slopes	1,862	.4			
Chelsea loamy sand, 12 to 18 percent slopes	909	.2			
Cohoctah loam	1,806	.4			
Colwood loam	5,129	1.2			
Conover loam, 0 to 2 percent slopes	10,903	2.6			
Conover loam, 2 to 6 percent slopes	13,467	3.2			
Del Rey silt loam, 0 to 2 percent slopes	1,794	.4			
Del Rey silt loam, 2 to 6 percent slopes	704	.2			

See footnote at end of table.

TABLE 1.—*Approximate acreage and proportionate extent of soils*—Continued

Soil	Acres	Percent
Marlette sandy loam, 2 to 6 percent slopes	4, 749	1. 1
Marlette sandy loam, 2 to 6 percent slopes, moderately eroded	4, 292	1. 0
Marlette sandy loam, 6 to 12 percent slopes	532	. 1
Marlette sandy loam, 6 to 12 percent slopes, moderately eroded	4, 085	1. 0
Marlette sandy loam, 6 to 12 percent slopes, severely eroded	331	. 1
Marlette sandy loam, 12 to 18 percent slopes, moderately eroded	739	. 2
Marlette sandy loam, 12 to 18 percent slopes, severely eroded	224	. 1
Marlette sandy loam, 18 to 25 percent slopes, moderately eroded	282	. 1
Marlette sandy loam, 25 to 60 percent slopes, moderately eroded	142	(1)
Matherton loam, 0 to 2 percent slopes	315	. 1
Matherton loam, 2 to 6 percent slopes	110	(1)
McBride loamy sand, 2 to 6 percent slopes	435	. 1
McBride loamy sand, 2 to 6 percent slopes, moderately eroded	188	(1)
McBride loamy sand, 6 to 12 percent slopes, moderately eroded	564	. 1
McBride sandy loam, 0 to 2 percent slopes	1, 061	. 3
McBride sandy loam, 2 to 6 percent slopes	8, 766	2. 1
McBride sandy loam, 2 to 6 percent slopes, moderately eroded	4, 357	1. 0
McBride sandy loam, 6 to 12 percent slopes	806	. 2
McBride sandy loam, 6 to 12 percent slopes, moderately eroded	3, 591	. 9
McBride sandy loam, 6 to 12 percent slopes, severely eroded	243	. 1
McBride sandy loam, 12 to 18 percent slopes	404	. 1
McBride sandy loam, 12 to 18 percent slopes, moderately eroded	795	. 2
McBride sandy loam, 12 to 18 percent slopes, severely eroded	329	. 1
McBride sandy loam, 18 to 25 percent slopes, moderately eroded	240	. 1
McBride sandy loam, 25 to 60 percent slopes	692	. 2
Menominee loamy sand, 0 to 2 percent slopes	1, 393	. 3
Menominee loamy sand, 2 to 6 percent slopes	4, 709	1. 1
Menominee loamy sand, 6 to 12 percent slopes	1, 257	. 3
Menominee loamy sand, 12 to 18 percent slopes	165	(1)
Metamora sandy loam, 0 to 2 percent slopes	547	. 1
Metamora sandy loam, 2 to 6 percent slopes	448	. 1
Miami loam, 2 to 6 percent slopes	7, 412	1. 8
Miami loam, 2 to 6 percent slopes, moderately eroded	5, 441	1. 3
Miami loam, 6 to 12 percent slopes	1, 850	. 4
Miami loam, 6 to 12 percent slopes, moderately eroded	8, 890	2. 1
Miami loam, 12 to 18 percent slopes	1, 081	. 3
Miami loam, 12 to 18 percent slopes, moderately eroded	2, 347	. 6
Miami loam, 18 to 25 percent slopes	416	. 1
Miami loam, 18 to 25 percent slopes, moderately eroded	603	. 1
Miami loam, 25 to 60 percent slopes	1, 201	. 3
Miami loam, 25 to 60 percent slopes, moderately eroded	182	(1)
Miami clay loam, 6 to 12 percent slopes, severely eroded	2, 665	. 6
Miami clay loam, 12 to 18 percent slopes, severely eroded	2, 369	. 6
Miami clay loam, 18 to 25 percent slopes, severely eroded	1, 035	. 2
Miami clay loam, 25 to 60 percent slopes, severely eroded	299	. 1
Montcalm loamy sand, 0 to 2 percent slopes	843	. 2
Montcalm loamy sand, 2 to 6 percent slopes	3, 283	. 8
Montcalm loamy sand, 6 to 12 percent slopes	1, 527	. 4
Montcalm loamy sand, 12 to 18 percent slopes	596	. 1
Montcalm loamy sand, 18 to 25 percent slopes	571	. 1
Montcalm loamy sand, 25 to 50 percent slopes	918	. 2
Montcalm sandy loam, 0 to 2 percent slopes	363	. 1
Montcalm sandy loam, 2 to 6 percent slopes	581	. 1
Morley loam, 2 to 6 percent slopes	2, 480	. 6
Morley loam, 2 to 6 percent slopes, moderately eroded	2, 597	. 6
Morley loam, 6 to 12 percent slopes	323	. 1
Morley loam, 6 to 12 percent slopes, moderately eroded	1, 597	. 4
Morley loam, 12 to 18 percent slopes, moderately eroded	367	. 1
Morley clay loam, 6 to 12 percent slopes, severely eroded	442	. 1
Morley clay loam, 12 to 18 percent slopes, severely eroded	383	. 1
Morley clay loam, 18 to 25 percent slopes, severely eroded	234	. 1
Munuscong sandy loam	133	(1)
Mussey-Gilford sandy loams	4, 051	1. 0
Nappanee loam, 0 to 2 percent slopes	1, 658	. 4
Nappanee loam, 2 to 6 percent slopes	829	. 2
Nappanee silty clay loam, 0 to 2 percent slopes	528	. 1
Nappanee silty clay loam, 2 to 6 percent slopes, moderately eroded	465	. 1
Oshtemo sandy loam, 0 to 2 percent slopes	245	. 1
Oshtemo sandy loam, 2 to 6 percent slopes	832	. 2
Oshtemo sandy loam, 6 to 12 percent slopes	222	. 1
Owosso sandy loam, 0 to 2 percent slopes	474	. 1
Owosso sandy loam, 2 to 6 percent slopes	1, 542	. 4
Owosso sandy loam, 6 to 12 percent slopes	217	. 1
Owosso sandy loam, 6 to 12 percent slopes, moderately eroded	264	. 1
Paulding clay	2, 539	. 6
Pewamo loam	6, 101	1. 4
Pewamo clay loam	588	. 1
Pinconning loamy sand	348	. 1
Richter sandy loam, 0 to 2 percent slopes	1, 084	. 3
Richter sandy loam, 2 to 6 percent slopes	320	. 1
Roselms clay loam, 0 to 2 percent slopes	2, 503	. 6
Roselms clay loam, 2 to 6 percent slopes	545	. 1
Roselms clay loam, 2 to 6 percent slopes, moderately eroded	195	(1)
St. Clair silty clay loam, 2 to 6 percent slopes, moderately eroded	181	(1)
St. Clair silty clay loam, 6 to 12 percent slopes, moderately eroded	241	. 1
Sebewa loam	2, 266	. 5
Sisson very fine sandy loam, 2 to 6 percent slopes	222	. 1
Sisson very fine sandy loam, 2 to 6 percent slopes, moderately eroded	412	. 1
Sisson very fine sandy loam, 6 to 12 percent slopes	147	(1)
Sisson very fine sandy loam, 6 to 12 percent slopes, moderately eroded	323	. 1
Sloan loam	2, 870	. 7
Spalding-Greenwood peats	1, 157	. 3
Spinks loamy sand, 0 to 2 percent slopes	413	. 1
Spinks loamy sand, 2 to 6 percent slopes	1, 818	. 4
Spinks loamy sand, 6 to 12 percent slopes	994	. 2
Spinks loamy sand, 12 to 18 percent slopes	803	. 2
Spinks loamy sand, 18 to 25 percent slopes	335	. 1
Spinks loamy sand, 25 to 50 percent slopes	156	(1)
Tawas muck	4, 345	1. 0
Tedrow loamy sand, 0 to 2 percent slopes	820	. 2
Tedrow loamy sand, 2 to 6 percent slopes	183	(1)
Tonkey fine sandy loam	689	. 2

See footnote at end of table.

TABLE 1.—*Approximate acreage and proportionate extent of soils*—Continued

Soil	Acres	Percent	Soil	Acres	Percent
Tuscola very fine sandy loam, 0 to 2 percent slopes	304	.1	Wasepi loamy sand, 0 to 2 percent slopes	860	.2
Tusco very fine sandy loam, 2 to 6 percent slopeas	1, 209	.3	Wasepi loamy sand, 2 to 6 percent slopes	1, 159	.3
Ubly sandy loam, 0 to 2 percent slopes	122	(1)	Willette muck	969	.2
Ubly sandy loam, 2 to 6 percent slopes	320	.1	Miscellaneous	2, 993	.7
Warnersmuck and marl	325	.1	Total	421, 760	100. 0

[1] Less than 0.05 percent.

Abscota Series

The Abscota series is made up of well-drained, nearly level soils that formed on flood plains in loamy sand and sand deposited by floodwater.

In a typical profile, the surface layer is very dark grayish-brown loamy sand about 10 inches thick. The underlying material consists of dark grayish-brown and brown, very friable to loose loamy sand and light yellowish-brown, stratified, loose loamy sand and sand.

The available water capacity is low, and permeability is rapid.

Flooding in spring and lack of moisture in summer are the major limitations. Floods seldom occur after May.

Most areas of Abscota soils are in woods. Some small fields are farmed, and some are used for native pasture.

Typical profile of Abscota loamy sand:

Ap—0 to 10 inches, very dark grayish-brown (10YR 3/2) loamy sand; moderate, fine, granular structure; very friable; moderately high in organic-matter content; slightly acid; abrupt, smooth boundary.

C1—10 to 15 inches, dark grayish-brown (10YR 4/2) loamy sand; weak, medium, granular structure; very friable; mildly alkaline; gradual, wavy boundary.

C2—15 to 28 inches, brown (10YR 4/3) loamy sand; single grain; loose; mildly alkaline; gradual, wavy boundary.

C3—28 to 42 inches +, light yellowish-brown (10YR 6/4), stratified loamy sand and sand; single grain; loose; calcareous.

The color of the A horizon is dark grayish brown or dark gray in some areas, and in small areas the texture is sandy loam. Layers of silt loam, fine sandy loam, and gravelly loam, less than 4 inches thick, are present locally.

Abscota soils formed in material similar to that in which Algansee and Glendora soils formed, but they are brighter colored and less mottled than those soils. They are coarser textured and less mottled than Ceresco soils.

Abscota loamy sand (0 to 2 percent slopes) (Ab).—This soil is on the flood plains of rivers and large streams throughout the county. In a few areas its surface layer is dark grayish-brown sandy loam. Small areas are gently sloping. Included in mapping were areas of Algansee and Glendora soils in former stream channels. These included soils are less well drained than Abscota soils; they dry out slowly in spring and after rain.

Flooding early in spring and lack of sufficient moisture during summer are the major limitations of this Abscota soil.

Most of the acreage is in woods. Small areas are used for corn, for forage crops, or for pasture. (Capability unit IVs–4 (L-4a); woodland suitability group O)

Adrian Series

The Adrian series is made up of dark-colored, very poorly drained, organic soils that occur in swampy areas on lake plains and in drainageways. These soils formed mainly from reeds, sedges, and grass. They are underlain with sand at a depth of 12 to 42 inches.

In a typical profile, the surface layer is very dark brown muck about 12 inches thick. Below the surface layer is yellowish-brown, friable, fibrous peat that extends to a depth of about 30 inches. Below this is gray, loose sand.

Natural fertility is low; the supplies of phosphorus, potassium, and micronutrients are deficient. The available water capacity is high. Permeability is rapid. Runoff is very slow or ponded. The water table is at or near the surface unless lowered by artificial drainage.

Most large areas are drained and farmed. Truck crops and sod are suitable crops. The smaller areas are in woods made up mainly of elm, soft maple, swamp white oak, and white-cedar.

Typical profile of Adrian muck:

1—0 to 12 inches, very dark brown (10YR 2/2) muck; weak, fine, granular structure; friable; neutral; clear, wavy boundary.

2—12 to 30 inches, yellowish-brown (10YR 5/4), fibrous peat; massive; friable; neutral; abrupt, smooth boundary.

IIC—30 to 42 inches +, gray (10YR 6/1) sand; single grain; loose; mildly alkaline.

The color of the uppermost layer is black or very dark grayish brown in places. In some areas the second layer consists of muck or peaty muck. The organic material is 12 to 42 inches thick. In reaction, it ranges from medium acid to mildly alkaline but is dominantly slightly acid or neutral. The texture of the IIC horizon is loamy sand in some areas.

Adrian soils are more fibrous than Tawas soils, and they have a thinner layer of organic material than either Greenwood or Houghton soils. They have coarser textured underlying material than Linwood or Willette soils.

Adrian muck (0 to 2 percent slopes) (Ad).—This soil occurs in swampy depressions on lake plains and in drainageways throughout the county. In places the surface layer is black rather than dark brown.

Excessive wetness is the main limitation for farming. Farm machinery bogs down easily when the soil is wet, and all farming operations are hampered. If the water table is lowered too much, the organic material settles. Low fertility, a hazard of soil blowing, and a hazard of frost damage, particularly in low spots, are added limitations.

If this soil is artificially drained, adequately fertilized, and protected against blowing, many short-season, frost-resistant truck crops can be grown. The large areas are farmed, and the small areas are in woods. (Capability unit IVw–5 (M/4c); woodland suitability group J)

Alcona Series

The Alcona series is made up of well drained and moderately well drained, level to sloping soils on outwash plains and moraines in the northern part of the county. These soils formed in water-laid material of sandy loam and loamy sand texture. In some places this material included layers of silt and fine sand also.

In a typical profile, the surface layer is dark grayish-brown sandy loam about 9 inches thick. The subsoil is about 17 inches thick. The upper 10 inches is dark yellowish-brown, friable sandy loam, and the lower 7 inches is yellowish-brown, friable heavy sandy loam. Beginning at a depth of about 26 inches are layers of strong-brown and pale-brown, very friable sandy loam and loamy fine sand.

Fertility is moderate. Water is absorbed readily, and runoff is slow to medium, depending on the slope. Nevertheless, the available water capacity is only moderate, and crops lack sufficient moisture during prolonged dry periods. Permeability is moderate.

Corn, small grain, forage crops, and pasture are the common crops. Oak, aspen, and sugar maple are the common kinds of trees. White pine grows in a few areas.

Typical profile of an Alcona sandy loam:

Ap—0 to 9 inches, dark grayish-brown (10YR 4/2) sandy loam; moderate, fine, granular structure; friable; slightly acid; abrupt, smooth boundary.

Bir—9 to 19 inches, dark yellowish-brown (10YR 4/4) sandy loam; moderate, medium, subangular blocky structure; friable; medium acid; clear, wavy boundary.

B't—19 to 26 inches, yellowish-brown (10YR 5/6) heavy sandy loam; moderate, fine, subangular blocky structure; friable; medium acid; gradual, wavy boundary.

IIC1—26 to 44 inches, strong-brown (7.5YR 5/6), stratified sandy loam and loamy fine sand; massive; very friable; slightly acid; gradual, wavy boundary.

IIC2—44 to 65 inches +, pale-brown (10YR 6/3) loamy fine sand and light sandy loam; single grain or massive; loose to very friable; slightly acid.

The color of the Ap horizon is dark brown or brown in some areas. In areas not yet cultivated, there is a very dark grayish-brown A1 horizon and a brownish-gray A2 horizon, each 1 to 3 inches thick. In some places a grayish-brown layer 1 to 3 inches thick lies between the Bir and the B't horizons. Thin layers of silt loam and loamy fine sand occur in the lower part of the B horizon in some areas. The reaction of the A and B horizons ranges from medium acid to slightly acid. The thickness of the A and B horizons combined ranges from 24 to about 42 inches. The reaction of the IIC horizon ranges from slightly acid to mildly alkaline.

Alcona soils have a coarser textured B horizon than either Sisson or Tuscola soils. They are finer textured than Montcalm soils, and they lack the alternate A'2 and B'2 horizons that are characteristic of Montcalm soils. Alcona soils lack the gravel that is characteristic of Boyer soils.

Alcona sandy loam, 0 to 2 percent slopes (AlA).—This soil is on outwash plains in the northern part of the county. Locally, areas of gently sloping Alcona soils were included with this level soil in mapping.

A shortage of available water in dry years is the main limitation for farming.

Nearly all of this soil is farmed. Corn and small grain are important crops. (Capability unit IIs–2 (3a); woodland suitability group A)

Alcona sandy loam, 2 to 6 percent slopes (AlB).—This soil is on outwash plains and low moraines in the northern part of the county. The slopes are generally uniform and are medium to long in length. Small areas of level Alcona soils were included in mapping.

Erosion is a hazard if row crops are grown where the slope is more than 3 percent. In some years the supply of available water is inadequate for optimum growth of crops.

Nearly all of this soil is farmed. Corn and small grain are important crops. (Capability unit IIe–3 (3a); woodland suitability group A)

Alcona sandy loam, 6 to 12 percent slopes (AlC).—This soil occurs as a few small areas on moraines in the northern part of the county. It has uniform, short to medium-length slopes. Included in mapping were small areas of moderately eroded Alcona soils on the crests of slopes. The surface layer of these eroded soils is lighter colored than that of the surrounding uneroded soil. Also included were small areas of less sloping Alcona soils.

The hazard of erosion is the main limitation for farming. A shortage of moisture in some years is also a limitation.

This soil is farmed. Corn, small grain, and forage crops are the common crops. (Capability unit IIIe–6 (3a); woodland suitability group A)

Algansee Series

The Algansee series is made up of somewhat poorly drained, level soils that occur on the flood plains of the rivers and larger streams. These soils formed in loamy sand and sand that was deposited by floodwater.

In a typical profile, the surface layer is very dark grayish-brown sandy loam about 12 inches thick. Below the surface layer, and extending to a depth of about 42 inches, is dark grayish-brown or grayish-brown, very friable loamy sand and loose sand mottled with yellowish brown and dark yellowish brown.

Fertility is low, permeability is rapid, the available water capacity is low, and runoff is slow. Flooding is likely early in spring, and the water table is seasonally high.

Most areas of Algansee soils, and especially most of those next to the Flint River, are in woods.

Typical profile of Algansee sandy loam:

Ap—0 to 12 inches, very dark grayish-brown (10YR 3/2) sandy loam; weak, fine, granular structure; very friable; moderately high in content of organic matter; neutral; abrupt, smooth boundary.

C1—12 to 15 inches, dark grayish-brown (10YR 4/2) loamy sand; common, medium, distinct, yellowish-brown (10YR 5/4) mottles; weak, medium, granular structure; very friable; neutral; gradual, wavy boundary.

C2—15 to 28 inches, grayish-brown (10YR 5/2) loamy sand; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; single grain; loose; neutral; gradual, wavy boundary.

C3—28 to 42 inches +, dark grayish-brown (10YR 4/2) sand; common, medium, faint, dark yellowish-brown (10YR 4/4) mottles; single grain; loose; calcareous.

The color of the A horizon is dark grayish brown or very dark brown in some areas. In some areas the underlying ma-

terial contains thin layers of fine gravel, sandy loam, or silt. The reaction, to a depth of 28 inches, ranges from slightly acid to mildly alkaline.

The material in which Algansee soils formed is similar to that in which Abscota soils and Glendora soils formed. Algansee soils are less well drained than Abscota soils; they are better drained than Glendora soils; and they have a coarser textured profile than Ceresco soils.

Algansee sandy loam (0 to 2 percent slopes) (An).—This soil is on the flood plains of rivers and large streams throughout the county. In a few areas the surface layer is loamy sand. Included in mapping were areas of Glendora and Tawas soils in old channels. These included soils are more poorly drained than Algansee soils and consequently are less well suited to crops.

Excessive wetness and flooding are the main limitations for farming. Drainage is difficult, partly because the water table is controlled by the level of the water in the streams and partly because of lack of gradient and lack of outlets.

Most of this soil is in woods. Small areas are used for hay or pasture. (Capability unit IIIw–14 (L–4c); woodland suitability group O)

Allendale Series

The Allendale series is made up of somewhat poorly drained, level to gently sloping soils on lake plains. These soils formed in sandy material underlain at a depth of 18 to 42 inches with clayey material.

In a typical profile, the surface layer is dark grayish-brown loamy sand about 10 inches thick. The subsoil is about 23 inches thick. The upper 16 inches is yellowish-brown to light brownish-gray, loose loamy sand mottled with dark yellowish brown. The lower 7 inches is dark yellowish-brown, friable light gravelly loam mottled with light brownish gray. The underlying material, at a depth of about 33 inches, is gray, very firm, limy clay mottled with light olive brown.

Fertility is low, and the available water capacity is low. Permeability is rapid in the sandy upper layers but slow in the fine-textured underlying material. Runoff is slow, and rainwater ponds in depressions. The water table is high in spring and after rain in other seasons. If it is lowered by artificial drainage, the soils dry out rapidly and tend to be droughty.

Most areas are used for crops, mainly corn, small grain, and hay. Small grain does better than corn in a dry year, because it matures while the moisture supply is still adequate.

Typical profile of an Allendale loamy sand:

Ap—0 to 10 inches, dark grayish-brown (10YR 4/2) loamy sand; weak, fine, granular structure; very friable; medium acid; abrupt, smooth boundary.

Bir—10 to 20 inches, yellowish-brown (10YR 5/4–5/6) loamy sand; single grain; loose; slightly acid; clear, wavy boundary.

A'2—20 to 26 inches, light brownish-gray (10YR 6/2) loamy sand; common, medium, distinct, dark yellowish-brown (10YR 4/4) mottles; single grain; loose; neutral; clear, wavy boundary.

IIB't—26 to 33 inches, dark yellowish-brown (10YR 4/4) light gravelly loam; common, medium, distinct, light brownish-gray (10YR 6/2) mottles; weak, medium, subangular blocky structure; friable; mildly alkaline; abrupt, wavy boundary.

IIICg—33 to 42 inches +, gray (N 6/0) clay; common, medium, distinct, light olive-brown (2.5Y 5/4) mottles; weak, medium, angular blocky structure; very firm; calcareous.

In some areas the color of the A horizon is very dark grayish brown, and in some the texture is sand. The texture of the IIICg horizon in some areas is clay. The depth to the IIICg horizon ranges from 24 to 36 inches. The reaction of the A and B horizons ranges from medium acid to mildly alkaline but is mainly slightly acid to neutral.

Allendale soils are better drained than Pinconning soils. They have finer textured underlying material than Iosco soils. They are similar in drainage to Au Gres soils, but Au Gres soils lack the underlying clay that is characteristic of Allendale soils.

Allendale loamy sand, 0 to 2 percent slopes (AoA).—This soil occurs as small areas on lake plains in the northern part of the county. Included in mapping were small areas of poorly drained Pinconning soils in drainageways and depressions. Also included were small areas of gently sloping Allendale soils.

Excessive wetness in spring and after rain in other seasons is the main limitation for farming. For optimum yields, many areas have to be drained by means of tile or open ditches. The spacing of and the depth to tile depend on the depth to clay. Installing tile is difficult because of the presence of pockets of unstable sand. After drainage, the soil is likely to be droughty. Soil blowing is a hazard if large areas are cultivated. Low fertility is an additional limitation.

Forage crops and corn are the crops commonly grown on this soil. Undrained areas are used mainly for pasture. (Capability unit IIIw–7 (4/1b); woodland suitability group G)

Allendale loamy sand, 2 to 6 percent slopes (AoB).—This soil occurs as small areas on lake plains in the northern part of the county. Included in mapping were slightly and moderately eroded areas on unprotected crests of slopes, mainly on slopes adjacent to drainageways. Also included were small spots where clay is at the surface; in these spots, germination of seeds is uneven and stands of plants are poor. Small areas of level Allendale soils were included also.

Excessive wetness in spring and after rain is the main limitation for farming. For optimum yields, many areas have to be artificially drained. Undulating relief makes the installation of a complete drainage system difficult, but random surface drains and tile drains are effective where outlets are available. The spacing of and depth to tile depend on the depth to clay. Installing tile is difficult because of the presence of pockets of unstable sand. After drainage, the soil is likely to be droughty. Soil blowing is a hazard if large areas are cultivated. Low fertility is an additional limitation.

Forage crops and corn are the crops commonly grown on this soil. Undrained areas are used mainly for pasture. (Capability unit IIIw–7 (4/1b); woodland suitability group G)

Au Gres Series

The Au Gres series is made up of level to undulating, somewhat poorly drained soils on lake plains and outwash plains in the northern part of the country. These soils formed in sandy material more than 66 inches thick.

They were affected during the period of formation by a fluctuating high water table.

In a typical profile, the surface layer is very dark grayish-brown loamy sand about 11 inches thick. The subsurface layer, about 2 inches thick, is light-gray, loose sand. The subsoil is about 11 inches thick. The upper 6 inches is dark reddish-brown, very friable sand, and the lower 5 inches is yellowish-brown, loose sand. The underlying material, at a depth of about 24 inches, is light-gray, loose sand mottled with light yellowish brown and yellowish brown.

Fertility is low, and the available water capacity is low. Runoff is slow, and water often ponds in depressions. If the water table has been lowered by artificial drainage, permeability is rapid in the sandy layers of these soils, but there is a loamy substratum phase in which permeability is restricted. The soils tend to be droughty after drainage, and the sandy texture makes it difficult to maintain the fertility and the organic-matter content.

Most areas of these soils are in woods. Drained areas can be farmed.

Typical profile of Au Gres loamy sand:

Ap—0 to 11 inches, very dark grayish-brown (10YR 3/2) loamy sand; very weak, fine, granular structure; very friable; high in organic-matter content; slightly acid; abrupt, smooth boundary.

A2—11 to 13 inches, light-gray (10YR 7/1) sand; single grain; loose; medium acid; abrupt, smooth boundary.

B21hir—13 to 15 inches, dark reddish-brown (5YR 3/3) sand; very weak, medium, subangular blocky structure; very friable; medium acid; gradual, wavy boundary.

B22ir—15 to 19 inches, dark reddish-brown (5YR 3/4) sand; weak, fine, granular structure; very friable; contains small lenses of weakly cemented sand; medium acid; clear, wavy boundary.

B23ir—19 to 24 inches, yellowish-brown (10YR 5/4) sand; single grain; loose; medium acid; clear, wavy boundary.

C—24 to 42 inches +, light-gray (2.5Y 7/2) sand; common, fine, distinct, light yellowish-brown (10YR 6/4) and yellowish-brown (10YR 5/6) mottles; single grain; loose; medium acid.

In areas not yet cultivated, there is a very dark gray or very dark grayish-brown A1 horizon about 1 to 4 inches thick. The A2 horizon is lacking in some places, mainly as a result of deeper than normal plowing. The reaction of the A and B horizons ranges from strongly acid to slightly acid.

Au Gres soils are better drained than Granby soils. They are more acid in the underlying material than Tedrow soils. They lack the underlying clay that is characteristic of Allendale soils.

Au Gres loamy sand, 0 to 6 percent slopes (AsB).—This soil is on lake plains and outwash plains in the northern part of the county. Included in mapping were areas of Granby soils in drainageways and depressions. These included soils are more poorly drained than Au Gres soils and dry out more slowly in spring and after rain.

Excessive wetness in spring is a limitation for farming. Ditches and tile drains are needed. Drainage systems are hard to install and maintain because the sandy soil material caves into trenches and ditches and filters into tile. Droughtiness is a limitation after the soil has been drained.

This soil is suitable for woods and native pasture. Most of it is in woods. (Capability unit IVw–2 (5b); woodland suitability group F)

Au Gres loamy sand, loamy substratum, 0 to 2 percent slopes (AuA).—This soil is on lake plains and outwash plains in the northern part of the county. It is underlain at a depth of 42 to 66 inches with loamy to clayey material. Included in mapping were small areas of gently sloping Au Gres soils.

The use of this soil is limited by excessive wetness in spring and after rain in other seasons and by a shortage of available water in dry periods. Fertility is low, and the organic-matter content is low.

This soil is suitable for trees and native pasture plants. Most of it is wooded. (Capability unit IVw–2 (5b); woodland suitability group F)

Barry Series

The Barry series is made up of level, poorly drained soils on moraines. These soils formed in sandy loam material.

In a typical profile, the surface layer is black loam about 12 inches thick. The subsoil is about 26 inches thick. It consists of 4 inches of dark grayish-brown, friable loam mottled with dark yellowish brown; 8 inches of grayish-brown, firm sandy clay loam mottled with light olive brown and dark yellowish brown; and 14 inches of light brownish-gray, friable heavy sandy loam mottled with yellowish brown. Below the subsoil, at a depth of about 38 inches, is light brownish-gray, friable, limy sandy loam mottled with olive yellow.

Fertility is moderate to moderately high. The available water capacity is moderate; normally, the supply is adequate for optimum growth of crops. Runoff is very slow, and water ponds in depressions and on flats. The water table is high in spring and during wet weather in other seasons. When the water table drops, permeability is moderate. If drained, these soils are easy to work and to keep in good tilth.

Most areas of these soils are in woods or are cultivated along with larger areas of other soils.

Typical profile of Barry loam:

A1—0 to 12 inches, black (10YR 2/1) loam; moderate, fine, granular structure; friable; high in content of organic matter; neutral; gradual, smooth boundary.

B21g—12 to 16 inches, dark grayish-brown (10YR 4/2) loam; common, medium, distinct, dark yellowish-brown (10YR 4/4) mottles; weak, fine, subangular blocky structure; friable; neutral; thin, very dark gray (10YR 3/1) coatings on ped faces; gradual, wavy boundary.

B22tg—16 to 24 inches, grayish-brown (2.5Y 5/2) sandy clay loam; common, medium, distinct, light olive-brown (2.5Y 5/6) and dark yellowish-brown (10YR 4/4) mottles; weak, medium, subangular blocky structure; firm; thin clay films on some peds; neutral; diffuse, wavy boundary.

B23tg—24 to 38 inches, light brownish-gray (10YR 6/2) heavy sandy loam; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; weak, coarse, subangular blocky structure; friable; mildly alkaline; abrupt, irregular boundary.

Cg—38 to 48 inches +, light brownish-gray (10YR 6/2) sandy loam; common, medium, distinct, olive-yellow (2.5Y 6/8) mottles; massive; friable; calcareous.

The color of the A horizon is very dark gray in some areas. The depth to the Cg horizon ranges from 24 to 44 inches. In some areas the Cg horizon contains thin layers of loamy sand and fine sand. The reaction of the A and B horizons ranges from slightly acid to mildly alkaline.

Barry soils have a coarser textured C horizon than Brookston soils and a finer textured C horizon than Gilford soils. They are more poorly drained and grayer than Locke soils.

Barry loam (0 to 2 percent slopes) (Ba).—This soil occurs in small drainageways and depressions on moraines throughout the county. In a few areas the surface layer is sandy loam. In low areas several inches of organic material has accumulated on the surface.

Most of the acreage is too wet to be used for crops unless artificially drained.

Some small areas of this soil are used for pasture, and some are cultivated, but most areas are in woods. (Capability unit IIw–6 (3c) ; woodland suitability group W)

Belding Series

The Belding series is made up of somewhat poorly drained, level to gently sloping soils on till plains and lake plains in the central and northern parts of the county. These soils formed in sandy loam or loamy sand material underlain at a depth of 18 to 42 inches with loam to silty clay loam.

In a typical profile, the surface layer is dark grayish-brown sandy loam about 7 inches thick. The subsoil is about 33 inches thick. The upper 16 inches consists of dark-brown, friable sandy loam over light brownish-gray, friable sandy loam mottled with yellowish brown. The lower part consists of brown, firm loam mottled with yellowish brown and light brownish gray over dark yellowish-brown, firm clay loam mottled with yellowish brown and grayish brown. The underlying material, at a depth of about 40 inches, is dark yellowish-brown, firm, limy clay loam mottled with grayish brown.

Fertility is moderate, and the available water capacity is moderate. The water table is near the surface in spring, unless lowered by artificial drainage. Permeability is moderately rapid in the upper part of the profile and moderately slow in the lower part. Tilth is generally good.

Most areas of these soils are used for crops.

Typical profile of a Belding sandy loam:

Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) sandy loam; weak, fine, granular structure; friable; slightly acid; abrupt, smooth boundary.

Bir—7 to 17 inches, dark-brown (7.5YR 4/4) sandy loam; weak, fine, subangular blocky structure; friable; medium acid; abrupt, irregular boundary.

A'2—17 to 23 inches, light brownish-gray (10YR 6/2) sandy loam; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; weak, medium, platy structure; friable; medium acid; clear, irregular boundary.

B'21—23 to 36 inches, brown (10YR 5/3) loam; common, fine, distinct, yellowish-brown (10YR 5/6) and light brownish-gray (10YR 6/2) mottles; moderate, medium, subangular blocky structure; firm; thin clay films on some ped faces; medium acid; clear, irregular boundary.

IIB'22—36 to 40 inches, dark yellowish-brown (10YR 4/4) clay loam; many, medium, faint, yellowish-brown (10YR 5/6) and distinct, grayish-brown (10YR 5/2) mottles; moderate, coarse, subangular blocky structure; firm; thin clay films on numerous peds; neutral; abrupt, wavy boundary.

IIC—40 to 60 inches +, dark yellowish-brown (10YR 4/4) clay loam; many, medium, distinct, grayish-brown (10YR 5/2) mottles; massive; firm; calcareous.

In areas not yet cultivated, there is a very dark gray A1 horizon 1 to 3 inches thick, and in some areas there is a light brownish-gray A2 horizon, also 1 to 3 inches thick. The reaction of the upper part of the B horizon is medium acid to slightly acid, and that of the lower part is medium acid to neutral.

Belding soils are more poorly drained than Ubly soils, which are not mottled. They are coarser textured in the upper part of the profile than Blount soils. They are finer textured in the upper part of the B horizon than Iosco soils.

Belding sandy loam, 0 to 2 percent slopes (BeA).—This soil is on till plains in the central and northern parts of the county. Included in mapping were small areas of gently sloping Belding soils, small areas in which the underlying material is clay or silty clay, and small depressions that dry out slowly.

Excessive wetness, especially in spring, is the major limitation for farming. Artificial drainage is needed for efficient production of crops.

If drained, this soil is suited to corn, small grain, and forage crops. Most of it is farmed. A few areas remain in woods. (Capability unit IIw–8 (3/2b) ; woodland suitability group G)

Belding sandy loam, 2 to 6 percent slopes (BeB).—This soil is on till plains in the central and northern parts of the county. In a few areas the plow layer contains small amounts of dark-brown sandy loam plowed up from the subsoil. Included in mapping were small areas of level Belding soils and small areas where the underlying material is silty clay or clay.

Excessive wetness, especially in spring, is the main limitation for farming. Artificial drainage is needed for efficient production of crops. Undulating topography makes it difficult to install a complete drainage system, but random tile and surface drains are effective.

If drained, this soil is suited to corn, small grain, and forage crops. Most of it is farmed. A few areas remain in woods. (Capability unit IIw–8 (3/2b) ; woodland suitability group G)

Belding Series, Clay Subsoil Variant

The clay subsoil variant of the Belding series is made up of somewhat poorly drained, level to undulating soils on lake plains. These soils formed in sandy loam underlain at a depth of 18 to 42 inches with clay or silty clay.

In a typical profile, the surface layer is very dark grayish-brown sandy loam about 9 inches thick. The subsoil is about 21 inches thick. The upper 15 inches is strong-brown and light brownish-gray, very friable light sandy loam. The lower 6 inches is dark yellowish-brown, firm loam mottled with light brownish gray. Underlying the subsoil is gray, very firm, limy clay mottled with light olive brown.

Fertility is moderate to low, and the available water capacity is moderate to low. Runoff is slow to very slow, and water ponds in depressions in wet weather. Permeability varies but is generally moderately rapid in the upper part of the profile and slow in the underlying clay. The water table is near the surface in spring, unless lowered by artificial drainage.

Most kinds of crops common in the county can be grown on these soils if excess water is removed by artificial drainage.

Typical profile of a Belding sandy loam, clay subsoil variant:

Ap—0 to 9 inches, very dark grayish-brown (10YR 3/2) sandy loam; weak, fine, granular structure; very friable; slightly acid; abrupt, smooth boundary.

Bir—9 to 18 inches, strong-brown (7.5YR 5/8) light sandy loam; few, fine, faint, brown (10YR 5/3) mottles; weak, medium, granular structure; very friable; slightly acid; clear, wavy boundary.

A'2—18 to 24 inches, light brownish-gray (10YR 6/2) light sandy loam; weak, thin, platy structure; very friable; neutral; abrupt, irregular boundary.

B't—24 to 30 inches, dark yellowish-brown (10YR 4/4) loam; many, medium, distinct, light brownish-gray (10YR 6/2) mottles; weak, fine, subangular blocky structure; firm; mildly alkaline; abrupt, wavy boundary.

IICg—30 inches +, gray (10YR 6/1) clay; common, medium, distinct, light olive-brown (2.5YR 5/4) mottles; weak, fine, angular blocky structure; very firm; calcareous.

In areas not yet cultivated, there is a very dark gray A1 horizon 2 to 4 inches thick and a light-gray A2 horizon 1 to 4 inches thick. In some areas the texture of the lower part of the B horizon is very heavy sandy loam or sandy clay loam. The reaction of the A and B horizons ranges from slightly acid to mildly alkaline.

These soils have finer textured upper layers than Allendale soils. They have finer textured underlying material than modal Belding soils.

Belding sandy loam, clay subsoil variant, 0 to 2 percent slopes (BfA).—This soil is on lake plains in the central and northern parts of the county. Included in mapping were small areas of Munuscong soils in drainageways. These included soils are more poorly drained and slower to dry out than Belding soils. Also included are small areas of gently sloping Belding soils.

Excessive wetness at some times during the growing season and droughtiness at others are the main limitations for farming.

Most of this soil is farmed. Small grain and corn are the principal crops. (Capability unit IIw–8 (3/2b); woodland suitability group G)

Belding sandy loam, clay subsoil variant, 2 to 6 percent slopes (BfB).—This soil is on lake plains and outwash plains in the central and northern parts of the county. In some areas the plow layer contains small amounts of strong-brown sandy loam plowed up from the subsoil. Included in mapping were small areas of level Belding soils and of slightly eroded soils on the crests of slopes.

Excessive wetness at some times during the growing season and droughtiness at others are the main limitations for farming. Drainage is needed for optimum production of crops. Some areas are hard to drain because of undulating relief.

Most of this soil is farmed. Small grain and corn are the principal crops. (Capability unit IIw–8 (3/2b); woodland suitability group G)

Berville Series

The Berville series is made up of poorly drained, level soils in drainageways and other low areas, mainly in the southern part of the county. These soils formed in loamy material underlain at a depth of 18 to 42 inches with loam or silty clay loam.

In a typical profile, the surface layer is very dark grayish-brown loam about 11 inches thick. The subsurface layer, about 3 inches thick, is very dark brown loam. The subsoil is about 32 inches thick. It consists of 8 inches of grayish-brown, friable, gravelly heavy loam mottled with yellowish brown; 14 inches of light brownish-gray, firm gravelly sandy clay loam mottled with yellowish brown and olive brown; and 10 inches of grayish-brown, firm gravelly clay loam mottled with dark brown and yellowish brown. Below the subsoil, at a depth of 40 inches, is grayish-brown, firm, limy loam mottled with yellowish brown.

Fertility is moderately high to high, and the available water capacity is moderately high to high. Permeability is moderately slow. Runoff is very slow, and water ponds in depressions during wet periods. The water table is high in spring and during wet weather in other seasons.

Corn and forage crops are grown in drained areas.

Typical profile of Berville loam:

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) loam; moderate, medium, granular structure; friable; slightly acid; abrupt, smooth boundary.

A1—8 to 11 inches, very dark brown (10YR 2/2) loam; moderate, coarse, granular structure; friable; neutral; gradual, wavy boundary.

B21tg—11 to 16 inches, grayish-brown (10YR 5/2) gravelly heavy loam; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; weak, medium, subangular blocky structure; friable; neutral; gradual, wavy boundary.

B22tg—16 to 30 inches, light brownish-gray (10YR 6/2) gravelly sandy clay loam; common, medium, distinct, yellowish-brown (10YR 5/6) and olive-brown (2.5Y 4/4) mottles; moderate, medium, subangular blocky structure; firm; mildly alkaline; gradual, wavy boundary.

B23tg—30 to 40 inches, grayish-brown (10YR 5/2) gravelly clay loam; common, coarse, distinct, dark-brown (10YR 4/3) and yellowish-brown (10YR 5/6) mottles; weak, coarse, subangular blocky structure; firm; thin clay films on numerous peds; mildly alkaline; abrupt, wavy boundary.

IICg—40 to 60 inches +, grayish-brown (10YR 5/2) loam; few, medium, distinct, yellowish-brown (10YR 5/6) mottles; weak, coarse, angular blocky structure; firm; calcareous.

In areas not yet cultivated, there is a black or very dark grayish-brown A horizon about 9 to 12 inches thick. The color of the Ap horizon in some areas is very dark brown. In places a 1- to 4-inch layer of gravel and sand lies between the B and C horizons. The texture of the IICg horizon is light clay loam in a few places. The reaction of the A and B horizons ranges from slightly acid to mildly alkaline.

Berville soils have more gravel in the B horizon than Brookston soils. They have finer textured B and C horizons than Gilford soils. They are more poorly drained than Macomb soils.

Berville loam (0 to 2 percent slopes (Bh).—This soil is in drainageways and other low areas in the southern part of the county. In many areas the plow layer contains considerable gravel. Included in mapping were small areas of Brookston and Gilford soils and of gently sloping Berville soils.

Excessive wetness, the main limitation for farming, is caused partly by a high water table and partly by runoff from higher soils nearby. Artificial drainage makes it possible to grow crops. Frost damage is a hazard to crops in the lowest areas.

Most of this soil is farmed. Corn and forage crops are the principal crops. Scattered small areas are in woods. (Capability unit IIw–8 (3/2c); woodland suitability group P)

Blount Series

The Blount series is made up of somewhat poorly drained, level to gently sloping soils on till plains. These soils formed in clay loam or silty clay loam material.

In a typical profile, the surface layer is very dark grayish-brown loam about 3 inches thick. The subsurface layer is pale-brown, friable loam about 5 inches thick. The subsoil, about 20 inches thick, is brown or yellowish-brown, firm silty clay loam and clay loam mottled with strong brown and grayish brown. Below the subsoil, at a depth of about 28 inches, is light-gray, firm, limy clay loam mottled with light olive brown.

Fertility is moderately high, and the available water capacity is high. Runoff is slow to ponded in level areas and medium in gently sloping areas. The profile is saturated in spring because of a seasonal high water table, and during wet weather at other times of the year because of moderately slow permeability. Unless artificially drained, these soils warm up and dry out slowly in spring. They puddle and clod if cultivated when wet.

Most of the acreage of these soils is farmed intensively.

Typical profile of a Blount loam:

O1—2 inches to 0, partly decomposed forest litter.
A1—0 to 3 inches, very dark grayish-brown (10YR 3/2) loam; moderate, fine, granular structure; friable; slightly acid; abrupt, wavy boundary.
A2—3 to 8 inches, pale-brown (10YR 6/3) loam; weak, very fine, subangular blocky structure; friable; medium acid; clear, wavy boundary.
B21t—8 to 12 inches, brown (10YR 5/3) heavy silty clay loam; many, medium, distinct, strong-brown (7.5YR 5/6) mottles; moderate, medium, angular blocky structure; firm; medium acid; clear, wavy boundary.
B22t—12 to 28 inches, yellowish-brown (10YR 5/6) heavy clay loam; many, common, distinct, grayish-brown (2.5YR 5/2) mottles; strong, medium, angular blocky structure; firm; gray (10YR 6/1) clay coatings on numerous ped faces; medium acid in upper part, grading with depth to neutral; abrupt, smooth boundary.
Cg—28 to 42 inches +, light-gray (10YR 6/1) clay loam; common, medium, distinct, light olive-brown (2.5Y 5/4) mottles; weak, medium, angular blocky structure; firm; calcareous.

The A1 horizon is 2 or 3 inches thick. The texture of the B horizon in some areas is light clay or silty clay. The depth to the C horizon ranges from 18 to 36 inches but is most commonly between 24 and 36 inches. The reaction of the A and B horizons ranges from medium acid to mildly alkaline.

Blount soils have a coarser textured B horizon than Nappanee soils and finer textured underlying material than Conover soils. They lack the variability and stratification in the C horizon that is characteristic of Del Rey soils.

Blount loam, 0 to 2 percent slopes (BlA).—This soil is on till plains throughout the county. Included in mapping were small areas of Pewamo soils in drainageways and depressions. Also included were small areas of gently sloping Blount soils and small areas in which the surface layer is sandy loam.

Wetness limits the use of this soil. Runoff is slow to ponded. Some areas lack outlets for drainage.

Most of this soil is farmed intensively. Corn, sugar beets, and forage crops can be grown in areas that are artificially drained. (Capability unit IIw–2 (1.5b); woodland suitability group Z)

Blount loam, 2 to 6 percent slopes (BlB).—This soil is on till plains throughout the county. In places the plow layer contains small amounts of brown silty clay loam plowed up from the subsoil. Included in mapping were small areas of Morley soils that have slopes of 4 to 6 percent. Also included were small areas of level Blount soils and areas in which the surface layer is sandy loam.

Excessive wetness is the main limitation for farming. Undulating topography makes it difficult to install a complete drainage system in some areas, but random tile and ditches are effective. Another limitation is a moderate hazard of erosion in intensively cultivated areas. Runoff is medium to slow.

Most of this soil is farmed intensively. Corn, sugar beets, and forage crops can be grown in areas that are artificially drained. (Capability unit IIw–3 (1.5b); woodland suitability group Z)

Blount loam, 2 to 6 percent slopes, moderately eroded (BlB2).—This soil is on till plains throughout the county. It has short, uniform slopes, generally of 3 to 5 percent. About half the original surface layer has been removed by erosion. The present plow layer is grayish-brown and contains small amounts of brown silty clay loam. It is lighter colored, less fertile, lower in organic-matter content, and more likely to crust than the plow layer of an uneroded Blount soil. Runoff is more rapid than on an uneroded soil, and consequently less water is available to plants. Included in mapping were spots of Blount soils so severely eroded that the subsoil is exposed.

Wetness, poor tilth, and an erosion hazard are limitations for farming. Undulating topography makes installation of a complete drainage system difficult in many areas, but random tile and ditches can be used to drain the wettest spots.

This soil is farmed intensively. Corn and forage crops are commonly grown. (Capability unit IIw–3 (1.5b); woodland suitability group Z)

Borrow Pits

Borrow pits (Bp) occur throughout the county, mostly adjacent to major highways. Nearly all the pits are in areas of coarse-textured to medium-textured, well drained to moderately well drained soils. Removal of soil material has destroyed the original soil profile. Some pits are too small to be outlined on the detailed soil map and are included within areas of other mapping units. (Capability unit VIIIs–1 (Sa); no woodland suitability classification)

Boyer Series

The Boyer series is made up of well-drained, level to steep soils on outwash plains and moraines. These soils formed in sandy loam or loamy sand and are underlain at a depth of 24 to 42 inches by strata of limy sand and gravel (fig. 7).

In a typical profile, the surface layer is dark grayish-brown loamy sand about 7 inches thick, and the subsurface layer is light yellowish-brown loamy sand about 8 inches thick. The subsoil is about 15 inches thick; the upper 9 inches is strong-brown, friable sandy loam, and the lower part is yellowish-red, firm gravelly sandy clay loam. At a depth of about 30 inches is brown, loose, limy, stratified sand and gravel.

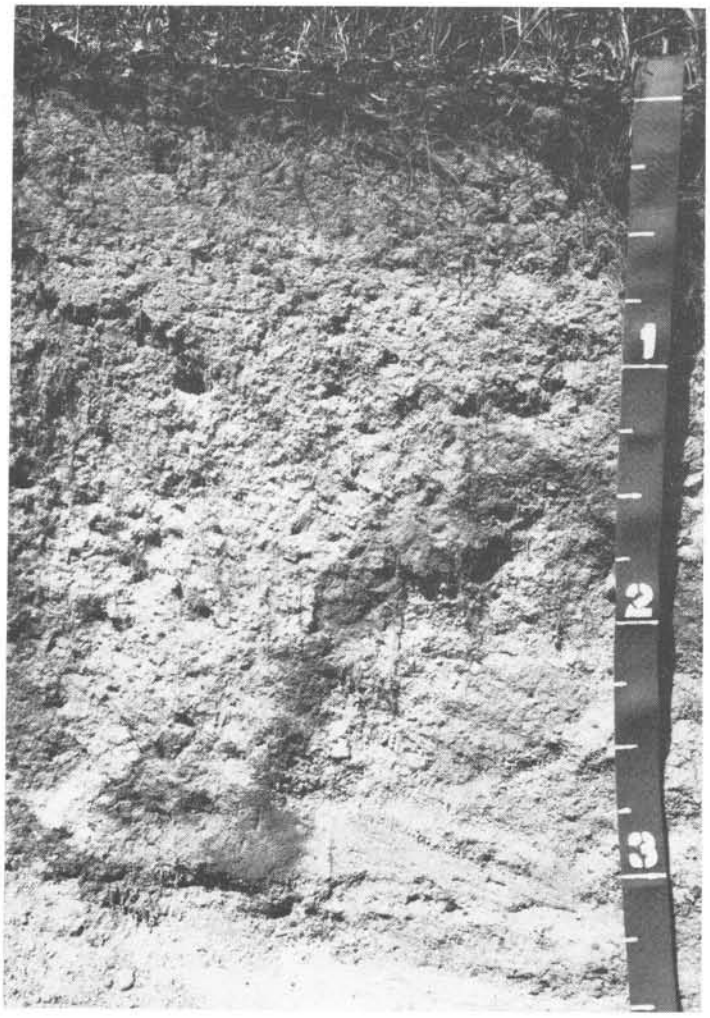

Figure 7.—**Profile of a Boyer loamy sand. Numbers on tape indicate depth in feet. Boyer soils are 24 to 42 inches deep to sand and gravel.**

Fertility is moderately low. Permeability is moderately rapid. The available water capacity is moderately low; the moisture supply is generally not adequate for optimum growth of crops and is especially likely to be deficient during the dry summer months.

Most of the level to sloping acreage is farmed. Corn, small grain, and hay are the major crops. Much of the more strongly sloping acreage has been farmed in the past but is now idle or is growing up to brush and trees. The steepest areas remain in woods.

Typical profile of a Boyer loamy sand:

Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) loamy sand; weak, fine, granular structure; very friable; slightly acid; abrupt, smooth boundary.

A2—7 to 15 inches, light yellowish-brown (10YR 6/4) loamy sand; weak, fine, granular structure; very friable; medium acid; clear, wavy boundary.

B21t—15 to 24 inches, strong-brown (7.5YR 5/8) light sandy loam; weak, medium, subangular blocky structure; friable; medium acid; clear, wavy boundary.

B22t—24 to 30 inches, yellowish-red (5YR 5/6) gravelly sandy clay loam; moderate, medium, subangular blocky structure; firm; slightly acid; abrupt, irregular boundary.

IIC—30 to 48 inches +, brown (10YR 5/3), stratified coarse sand and fine gravel; single grain; calcareous.

The color of the Ap horizon is brown in some places. In areas not cultivated, there is a very dark grayish-brown A1 horizon that is 1 to 3 inches thick. The combined thickness of the Ap and A2 horizons ranges from 12 to about 20 inches. The texture of the B21t horizon is loam in some places, and that of the B22t horizon is sandy loam, gravelly clay loam, or clay loam. The texture of the IIC horizon is dominantly sand in some places. The reaction of the A and B horizons ranges from medium acid to neutral.

Boyer soils have a lower total clay content throughout the profile than Fox soils. They have a finer textured B horizon than Spinks soils. The depth to the limy IIC horizon is less in Boyer soils than in Oshtemo soils.

Boyer loamy sand, 0 to 2 percent slopes (BrA).—This soil is on outwash plains. In some areas the plow layer contains fine gravel. Included in mapping were areas of Wasepi soils in small depressions and narrow drainageways. These included soils dry out slowly in spring and after rain.

Permeability of this Boyer soil is moderately rapid. The available water capacity is moderately low, and lack of sufficient moisture during much of the growing season is a major limitation. There is little or no hazard of water erosion, because surface runoff is very slow, but soil blowing is a hazard if large areas are left bare of vegetation.

Nearly all of this soil is farmed. Corn, small grain, and forage crops are the major crops. (Capability unit IIIs–3 (4a); woodland suitability group M)

Boyer loamy sand, 2 to 6 percent slopes (BrB).—This soil occurs both on outwash plains and on moraines. On the outwash plains, the slopes are long and uniform; on the uplands, the slopes are short to medium in length and are irregular in shape. Next to drainageways, the slopes have a gradient of 4 to 6 percent. In some areas the plow layer contains strong-brown sandy loam plowed up from the subsoil. Included in mapping were areas of Wasepi and Brady soils in narrow drainageways. These included soils dry out slowly in spring and after rain. Also included were small areas of level Boyer soils.

Permeability of this Boyer soil is moderately rapid. The available water capacity is moderately low, and lack of sufficient moisture during much of the growing season is a major limitation. Surface runoff is slow to medium; consequently, there is a slight hazard of water erosion. Soil blowing is a hazard if the surface is bare.

Most of this soil is farmed. Corn, small grain, and forage crops are the major crops. (Capability unit IIIs–4 (4a); woodland suitability group M)

Boyer loamy sand, 6 to 12 percent slopes (BrC).—This soil is on moraines. The slopes are short to medium in length and either uniform or irregular in shape. Where organic matter has accumulated, the color of the uppermost 2 to 4 inches is very dark grayish brown to very dark brown. A few areas included in mapping are moderately eroded, and in these places the surface layer is browner than elsewhere and is more likely to crust.

Permeability of this soil is moderately rapid. The available water capacity is moderately low. Surface runoff is medium or moderately rapid in cultivated areas. The erosion hazard and lack of moisture during the growing season are the major limitations. Where the slopes are short and irregular, it is difficult to farm on the contour or to lay out terraces and diversions for control of runoff.

Less erosion takes place if grasses and legumes are grown instead of cultivated crops.

Much of this soil is in woods or pasture. Corn, small grain, and forage crops are the major cultivated crops. (Capability unit IIIe–9 (4a); woodland suitability group M)

Boyer loamy sand, 12 to 18 percent slopes (BrD).—This soil is on moraines. The slopes are short and irregular. Included in mapping were small areas in which the gradient is less than 12 percent; these areas are on ridges and knolls and at the base of slopes. Also included are small areas, next to drainageways and depressions, in which the gradient is more than 18 percent.

Runoff is rapid in cultivated areas of this soil, and the short, irregular slopes make it difficult to farm on the contour or to lay out terraces for control of runoff. The erosion hazard and a lack of sufficient moisture are the major limitations.

Nearly all of this soil is in woods. A limited acreage is used for cultivated crops, orchards, native pasture, and forage crops. Cultivated crops should be grown only occasionally, because of the risk of erosion. Trees and drought-resistant pasture plants are better suited. (Capability unit IVe–9 (4a); woodland suitability group M)

Boyer loamy sand, 18 to 25 percent slopes (BrE).—This soil occurs as small areas on moraines. Where organic matter has accumulated, the color of the uppermost 2 to 4 inches of the surface layer is very dark grayish brown. The slopes are short and irregular, and the gradient varies considerably within short distances. A few areas included in mapping are moderately eroded, and a few are severely eroded. Runoff is more rapid and tilth is poorer in these eroded areas than elsewhere; germination of seeds is uneven, and stands of plants are poor.

The slope and the erosion hazard are severe limitations. Runoff is rapid, and little water soaks in. Operating farm machinery safely is difficult.

Almost all of this soil is in woods. A few areas are in native pasture. The permanent vegetation helps to control erosion. (Capability unit VIe–2 (4a); woodland suitability group M)

Boyer loamy sand, 25 to 50 percent slopes (BrF).—This soil is on moraines. The slopes are short and irregular, and the gradient varies considerably within short distances. Included in mapping were slopes of lesser gradient on hills, knolls, and spurs and at the base of slopes; very short, uniform slopes on long bluffs next to major drainageways, large muck depressions, and lakes; and small areas of Fox soils, which are on the crests of ridges.

The slope and the erosion hazard are very severe limitations. Operating farm machinery safely is difficult. Trees and native pasture plants are suitable vegetation.

Almost all of this soil is in woods. A few areas are in native pasture. (Capability unit VIIe–2 (4a); woodland suitability group M)

Boyer sandy loam, 0 to 2 percent slopes (BsA).—This soil occurs both on outwash plains and on moraines. In some areas the plow layer contains fine gravel. Included in mapping were areas of Wasepi soils in small depressions and narrow drainageways.

Permeability of this Boyer soil is moderately rapid. The available water capacity is moderately low, and lack of sufficient moisture during much of the growing season is a major limitation. There is little or no hazard of water erosion, because surface runoff is very slow, but soil blowing is a slight hazard if large areas are left unprotected.

Nearly all of this soil is farmed. Corn, small grain, and forage crops are the major crops. (Capability unit IIIs–3 (4a); woodland suitability group M)

Boyer sandy loam, 2 to 6 percent slopes (BsB).—This soil occurs as extensive areas both on outwash plains and on moraines. On the outwash plains, the slopes are long and uniform or gently undulating; on the uplands, the slopes are short to medium in length and more irregular in shape. The slopes next to drainageways on the uplands commonly have a gradient of 4 to 6 percent. Small areas on the outwash plains are level. Included in mapping were areas of Wasepi soils in narrow drainageways. Wasepi soils are somewhat poorly drained; they dry out slowly in spring and after rain.

Permeability of this Boyer soil is moderately rapid. The available water capacity is moderately low, and lack of sufficient moisture during much of the growing season is a major limitation. Runoff is slow to medium; consequently, there is a slight hazard of water erosion. Soil blowing is a hazard if the surface is left bare.

Most of this soil is farmed. Corn, small grain, and forage crops are the major crops. (Capability unit IIIs–4 (4a); woodland suitability group M)

Boyer sandy loam, 6 to 12 percent slopes (BsC).—This soil is on moraines. The slopes are short to medium in length and either uniform or irregular in shape.

Permeability of water is moderately rapid, and the available water capacity is moderately low. Runoff is medium to rapid in cultivated areas. The major limitations are the erosion hazard and a lack of sufficient moisture during much of the growing season. Where the slopes are short and irregular, it is difficult to farm on the contour or to lay out terraces and diversions for control of runoff. Less erosion takes place if grasses and legumes are grown instead of cultivated crops.

Most of this soil is farmed. Corn, small grain, and forage crops are the major crops. (Capability unit IIIe–9 (4a); woodland suitability group M)

Boyer sandy loam, 12 to 18 percent slopes (BsD).—This soil occurs as small areas on moraines. The slopes are short and irregular, and they vary considerably in gradient within short distances. The plow layer is brown heavy sandy loam. Erosion has removed part of the original surface layer from some areas, and in a few areas material from the subsoil has been mixed into the plow layer. Rills have developed in some areas. Included in mapping were severely eroded spots, in which germination of seed is uneven and stands of plants are poor. Also included were small areas of Fox soils.

This Boyer soil is severely limited by the slope, rapid runoff, and the resulting erosion hazard. In some areas erosion has already lowered the organic-matter content and impaired the fertility and the available water capacity. The short, irregular slopes make it difficult to farm on the contour or to lay out terraces for control of runoff.

This soil should be cultivated only occasionally. Trees and drought-resistant pasture plants are better suited than cultivated crops. Nevertheless, most of the acreage is farmed. (Capability unit IVe–9 (4a); woodland suitability group M)

Brady Series

The Brady series is made up of somewhat poorly drained, level to gently sloping or undulating soils on outwash plains. These soils formed in loamy sand, sand, and gravelly material.

In a typical profile, the surface layer is very dark grayish-brown loamy sand about 10 inches thick. The subsurface layer, about 12 inches thick, is pale-brown, very friable loamy sand mottled with yellowish brown. The subsoil is about 26 inches thick. It consists mainly of light brownish-gray and pale-brown, friable sandy loam mottled with strong brown, yellowish brown, and light gray. Pale-brown, loose, limy, stratified sand and gravel underlie the subsoil at a depth of about 48 inches.

Fertility is moderate to low, and the available water capacity is moderate to moderately low. The water table is high in spring and during wet weather in other seasons. Permeability is moderate to moderately rapid except when the water table is high. If the water table is lowered by artificial drainage, the soils dry out quickly and tend to be droughty.

Typical profile of a Brady loamy sand:

Ap—0 to 10 inches, very dark grayish-brown (10YR 3/2) loamy sand; weak, fine, granular structure; very friable; medium acid; abrupt, smooth boundary.

A2—10 to 22 inches, pale-brown (10YR 6/3) loamy sand; common, medium, distinct, yellowish-brown (10YR 5/8) mottles; weak, medium, granular structure; very friable; medium acid; gradual, wavy boundary.

B21t—22 to 34 inches, light brownish-gray (10YR 6/2) light sandy loam; common, medium, distinct, strong-brown (7.5YR 5/8) mottles; weak, medium, subangular blocky structure; very friable; medium acid; gradual, wavy boundary.

B22t—34 to 48 inches, pale-brown (10YR 6/3) heavy sandy loam; many, medium, distinct, yellowish-brown (10YR 5/6) and faint, light-gray (10YR 7/2) mottles; weak, medium, subangular blocky structure; friable; slightly acid; abrupt, smooth boundary.

IIC—48 to 60 inches +, pale-brown (10YR 6/3), stratified coarse sand and fine gravel; single grain; loose; calcareous.

In areas not yet cultivated, there is a very dark gray A1 horizon 2 to 5 inches thick. The color of the Ap horizon is very dark gray in some areas. The texture of the IIC horizon ranges from dominantly coarse sand to a mixture of fine gravel and sand. The reaction of the A and B horizons ranges from medium acid to slightly acid.

The material in which Brady soils formed was similar to that in which Oshtemo soils formed, but Brady soils are more poorly drained than Oshtemo soils and have a more mottled B horizon. Brady soils have a thicker and more acid B horizon than Wasepi soils. They have a thicker and coarser textured B horizon than Matherton soils.

Brady loamy sand, 0 to 2 percent slopes (BtA)—This soil is on outwash plains throughout the county. In places the plow layer is sandy loam. Included in mapping were areas of gently sloping soils and of soils in which loam to heavy silty clay loam occurs at a depth of 42 to 66 inches.

Unless artificially drained, this soil has severe limitations for crops, pasture, and trees. It warms up and dries out slowly, and there are small depressions that stay wet longer than the surrounding soil. Drainage is difficult because the sandy soil material is unstable, especially when wet, and tends to cave into trenches and ditches. Other limitations are moderate to low fertility, a hazard of frost damage in low areas, and a shortage of available water during dry periods.

Most of this soil is in forage crops and pasture. Scattered areas are in woods. (Capability unit IIIw–5 (4b); woodland suitability group G)

Brady loamy sand, 2 to 6 percent slopes (BtB).—This soil is on outwash plains throughout the county. Included in mapping were areas in which the surface layer is sandy loam; areas of level Brady soils, which have slower surface drainage than the surrounding gently sloping soil; and areas in which loam to heavy silty clay loam occurs at a depth of 42 to 66 inches.

Unless artificially drained, this soil has severe limitations for crops, pasture, and trees. It warms up and dries out slowly, and there are small depressions and drainageways that stay wet longer than the surrounding soil. Installing a complete drainage system is difficult in many areas because of undulating relief, but random tile and ditches are effective in such places. Ditches and tile trenches are unstable when the soil is wet. Some areas lack outlets for drainage. Other limitations are moderate to low fertility, a frost hazard in low areas, and a shortage of available water during periods of dry weather.

Most of this soil is in forage crops and pasture. Scattered areas are in woods. (Capability unit IIIw–5 (4b); woodland suitability group G)

Breckenridge Series

This series is made up of poorly drained, level or depressional soils on lake plains and till plains in the central and northern parts of the county. These soils formed in sandy loam over loam, clay loam, or silty clay loam.

In a typical profile, the surface layer is black sandy loam about 9 inches thick. The subsoil, about 18 inches thick, consists of 3 inches of gray, very friable sandy loam over 15 inches of dark-gray, friable heavy sandy loam mottled with yellowish brown. Below the subsoil, at a depth of about 27 inches, is gray, firm, limy silty clay loam mottled with olive brown.

Fertility is medium, and the available water capacity is medium. Runoff is slow to ponded. Permeability is moderately rapid in the upper part of the profile and moderately slow in the lower part. Runoff from higher areas accumulates on these soils, and in undrained areas the water table is at a depth of less than 12 inches. The gray color of the subsoil is an indication of prolonged wetness. The soils dry out slowly in spring and after prolonged rain in other seasons, and the high water table limits the growth of roots and makes the use of farm machinery difficult.

If drained, these soils are used for crops, mainly corn and forage crops. Undrained areas are mainly in pasture or woods.

Typical profile of Breckenridge sandy loam:

Ap—0 to 9 inches, black (10YR 2/1) sandy loam; weak, medium, granular structure; very friable; high in organic-matter content; mildly alkaline; abrupt, smooth boundary.

B21g—9 to 12 inches, gray (5YR 5/1) sandy loam; weak, coarse, granular structure; very friable; mildly alkaline; gradual, irregular boundary.

B22g—12 to 27 inches, dark-gray (5YR 4/1) heavy sandy loam; common, medium, distinct, yellowish-brown

(10YR 5/4) mottles; weak, medium, subangular blocky structure; friable; mildly alkaline; clear, wavy boundary.

IIC—27 to 42 inches +, gray (5Y 5/1) silty clay loam; many, coarse, distinct, light olive-brown (2.5Y 5/4) mottles; massive; firm; calcareous.

In some areas a 2- to 10-inch layer of muck covers the surface. The texture of the B horizon is light clay loam in some areas, and pockets or lenses of sand and sandy loam occur. The depth to the IIC horizon ranges from 18 to 42 inches. The reaction of the A and B horizons is mainly neutral to mildly alkaline.

Breckenridge soils are more poorly drained and have a grayer B horizon than Belding soils. They have a finer textured subsoil than Pinconning soils and a coarser textured subsoil than Pewamo soils.

Breckenridge sandy loam (0 to 2 percent slopes) (Bu).—This soil is on till plains and lake plains in the central and northern parts of the county. The plow layer is high in organic-matter content and in some places is very dark grayish brown rather than black. Included in mapping were a few small areas of Linwood muck in depressions.

Unless artificially drained by tile and ditches, this soil has moderate limitations for crops, pasture plants, and trees. It warms up and dries out slowly in spring, and there are small depressions that stay wet longer than surrounding areas. Some areas lack outlets for drainage. The depth to and spacing of tile depend on the depth to the moderately fine textured underlying material. Frost damage is a hazard in the lowest areas.

The larger areas of this soil are drained and intensively farmed. Corn and forage crops are the main crops. The smaller areas are still in woods. (Capability unit IIw–8 (3/2c); woodland suitability group W)

Brevort Series

The Brevort series is made up of poorly drained, level or depressional soils on lake plains and outwash plains in the central and northern parts of the county. These soils formed in sand or loamy sand 18 to 42 inches thick over loam, silty clay loam, or clay loam.

In a typical profile, the surface layer is very dark gray loamy sand about 10 inches thick. The subsoil is about 18 inches thick. The upper 12 inches is grayish-brown, very friable loamy fine sand over light brownish-gray, loose loamy sand. In some profiles the loamy sand layer contains lenses of gray and olive-brown silty clay loam. The lower 6 inches of the subsoil is gray, friable sandy loam mottled with light yellowish brown. Below the subsoil is a 6-inch layer of yellowish-brown and light-gray, loose, limy coarse sand and fine gravel mottled with yellowish brown. At a depth of 34 inches is light olive-brown, firm, limy clay loam mottled with light gray.

Fertility is low. The sandy upper layers have a moderately low available water capacity; the finer textured lower layers hold more water and help to keep the sandy layers moist. Runoff is very slow to ponded. Permeability is rapid in the sandy upper layers and moderate in the finer textured lower layers. Runoff from adjoining higher soils accumulates, and the water table is at a depth of less than 12 inches in spring, unless lowered by artificial drainage. The gray color of the subsoil is an indication of prolonged wetness. The soils warm up and dry out slowly in spring and after prolonged rain in other seasons, and in some years they are wet enough in fall that harvesting of crops is delayed or even prevented. Unless lowered artificially, the water table restricts the growth of roots and makes it difficult to use farm machinery.

Drained areas of these soils are used for crops and pasture. Undrained areas are in woods or native pasture.

Typical profile of Brevort loamy sand:

Ap—0 to 10 inches, very dark gray (10YR 3/1) loamy sand; moderate, medium, granular structure; very friable; slightly acid; abrupt, smooth boundary.

B21—10 to 15 inches, grayish-brown (10YR 5/2) loamy fine sand; weak, fine, granular structure; very friable; neutral; clear, wavy boundary.

B22—15 to 22 inches, light brownish-gray (10YR 6/2) loamy sand; thin lenses of gray (2.5Y 5/0) and olive-brown (2.5Y 4/4) silty clay loam; single grain; loose; neutral; gradual, wavy boundary.

IIB23g—22 to 28 inches, gray (10YR 5/1) coarse sandy loam; few, fine, distinct, light yellowish-brown (10YR 6/4) mottles; weak, medium, subangular blocky structure; friable; mildly alkaline; clear, wavy boundary.

IIIC1—28 to 34 inches, yellowish-brown (10YR 5/4) coarse sand and fine gravel; many, medium, distinct, light-gray (10YR 6/1) mottles; single grain; loose; calcareous; abrupt, wavy boundary.

IVC2—34 to 44 inches +, light olive-brown (2.5Y 5/4) clay loam; many, fine, distinct, light-gray (10YR 6/1) mottles; massive; firm; calcareous.

In areas not yet farmed, there is a very dark gray or black A1 horizon 5 to 10 inches thick. The texture of the IVC horizon is loam, clay loam, or silty clay loam. Some profiles lack a IIIC horizon. The reaction of the A and B horizons ranges from slightly acid to mildly alkaline.

Brevort soils developed in material similar to that in which Iosco soils developed. They are more poorly drained than Iosco soils. Brevort soils have coarser textured A, B21, and B22 horizons than Breckenridge soils, and they have coarser textured underlying material than Pinconning soils.

Brevort loamy sand (0 to 2 percent slopes) (Bv).—This soil is on outwash plains and lake plains in the central and northern parts of the county.

Runoff from adjoining higher areas makes this soil excessively wet, especially in the early part of the growing season. Artificial drainage is needed for efficient production of crops. Crops in the lowest areas are subject to frost damage.

Most areas of this soil are in woods. Corn and forage crops can be grown in areas that are drained artificially. (Capability unit IIIw–10 (4/2c); woodland suitability group W)

Brookston Series

The Brookston series is made up of poorly drained, level or depressional soils on till plains. These soils formed in loam or light clay loam material.

In a typical profile (fig. 8), the surface layer is very dark brown loam about 12 inches thick. The subsoil, about 26 inches thick, is gray, firm clay mottled with yellowish brown. The underlying material, at a depth of about 38 inches, is light-gray, firm, limy loam mottled with brownish yellow.

Fertility is high, the available water capacity is high, permeability is moderately slow, and runoff is very slow to ponded. The water table is high in spring and after rain in other seasons. The gray color of the subsoil results from prolonged saturation. After the soils have been drained and have dried out, they are easy to work and easy to keep in good tilth.

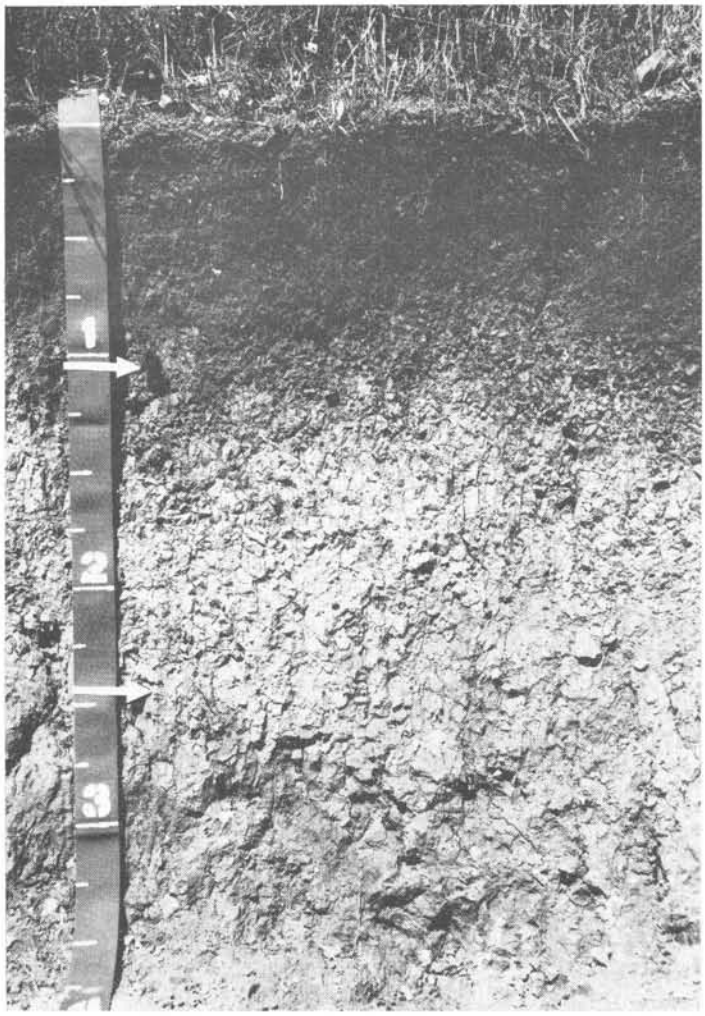

Figure 8.—**Profile of Brookston loam, a poorly drained soil that has a very dark brown surface layer and a gray subsoil. Numbers on tape indicate depth in feet.**

Most of the common crops can be grown in drained areas of Brookston soils.

Typical profile of Brookston loam:

Ap—0 to 8 inches, very dark brown (10YR 2/2) loam; moderate, medium, granular structure; friable; slightly acid; abrupt, wavy boundary.

A1—8 to 12 inches, very dark brown (10YR 2/2) heavy loam; moderate, coarse, granular structure; friable; slightly acid; gradual, wavy boundary.

B21tg—12 to 15 inches, gray (10YR 6/1) light clay loam; many, medium, distinct, yellowish-brown (10YR 5/6) mottles; moderate, medium, subangular blocky structure; firm; very dark brown (10YR 2/2) coatings on ped faces; neutral; gradual, wavy boundary.

B22tg—15 to 38 inches, gray (10YR 6/1) clay loam; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; weak, medium, prismatic structure breaking to moderate, medium, subangular blocky; firm; thin to thick clay films on numerous peds; mildly alkaline; abrupt, irregular boundary.

Cg—38 to 48 inches +, light-gray (10YR 7/1) loam; common, medium, distinct, brownish-yellow (10YR 6/6) mottles; weak, coarse, subangular blocky structure; firm; calcareous.

The color of the A horizon is black or very dark gray in some areas. In thickness, this horizon ranges from 10 to 14 inches. The texture of the B horizon is silty clay loam in some areas. The thickness of the A and B horizons combined ranges from 32 to about 50 inches. The reaction of these horizons ranges from slightly acid to mildly alkaline.

Brookston soils have a finer textured C horizon than Barry soils. They developed in material similar to that in which Conover soils developed but are more poorly drained than Conover soils and have a grayer B horizon.

Brookston loam (0 to 2 percent slopes) (Bw).—This soil is on till plains throughout the county. Included with it in mapping were a few areas of gently sloping Brookston soils.

Unless artificially drained by tile and ditches, this soil has severe limitations for crops, pasture, and trees. It warms up and dries out slowly in spring, and there are small depressions and drainageways that stay wet longer than the surrounding areas. Farm machinery bogs down readily during wet weather in spring and fall. The soil material is stable, and tile and ditches are easily maintained. Some areas lack outlets for drainage. Frost damage is a hazard to crops in low areas.

Most of this soil is farmed intensively. Corn is the crop most commonly grown. Scattered small areas are in woods. (Capability unit IIw–4 (2.5c); woodland suitability group P)

Capac Series

The Capac series is made up of somewhat poorly drained, level to undulating soils on till plains. These soils formed in loamy material and were affected during formation by a fluctuating high water table.

In a typical profile, the surface layer is very dark grayish-brown fine sandy loam about 5 inches thick. The subsoil is about 29 inches thick. The upper 7 inches consists of yellowish-brown, very friable sandy loam over light brownish-gray, very friable sandy loam mottled with yellowish brown. The lower 22 inches is grayish-brown and yellowish-brown, firm clay loam mottled with yellowish brown, gray, and grayish brown. Below the subsoil, at a depth of about 34 inches, is gray, firm, limy loam mottled with yellowish brown.

Fertility is high, and the available water capacity is high. Runoff is slow. Water that runs off higher surrounding soils accumulates, and the water table is within a foot or two of the surface in spring and after rain in other seasons. Permeability is moderately slow, except when the water table is high. After the soils have been drained and have dried out, they are easy to work and easy to keep in good tilth.

Most of the acreage is used for crops.

Typical profile of a Capac fine sandy loam:

O1—2 inches to 0, forest litter derived from deciduous trees.

A1—0 to 5 inches, very dark grayish-brown (10YR 3/2) fine sandy loam; moderate, medium, granular structure; friable; slightly acid; clear, irregular boundary.

B1—5 to 8 inches, yellowish-brown (10YR 5/6) sandy loam; weak, fine, subangular blocky structure; very friable; strongly acid; clear, wavy boundary.

A'2—8 to 12 inches, light brownish-gray (10YR 6/2) sandy loam; common, medium, distinct, yellowish-brown (10YR 5/4) mottles; weak, fine, subangular blocky structure; very friable; strongly acid; clear, wavy boundary.

B'21t—12 to 18 inches, grayish-brown (10YR 5/2) clay loam; common, medium, distinct, yellowish-brown (10YR

5/6) mottles; moderate, coarse, subangular blocky structure; firm; neutral; gradual, wavy boundary.

B'22t—18 to 29 inches, yellowish-brown (10YR 5/6) clay loam; many, medium, faint, grayish-brown (2.5Y 5/2) mottles; moderate, fine, subangular blocky structure; firm; neutral; gradual, wavy boundary.

B'23tg—29 to 34 inches, grayish-brown (10YR 5/2) clay loam; many, medium, faint, gray (10YR 5/1) and distinct, yellowish-brown (10YR 5/6) mottles; moderate, medium, subangular blocky structure; firm; mildly alkaline; abrupt, wavy boundary.

Cg—34 to 48 inches +, gray (10YR 5/1) loam; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; weak, medium, subangular blocky structure; firm; calcareous.

In cultivated areas these soils have a very dark grayish-brown or dark grayish-brown Ap horizon 6 to 10 inches thick. In some areas the texture of the lower part of the B horizon is silty clay loam. The reaction of the upper part of the B horizon ranges from strongly acid to slightly acid, and that of the lower part from medium acid to mildly alkaline.

Capac soils are less well drained than Marlette soils, which are not mottled. They are better drained and less gray than Brookston soils.

Capac fine sandy loam, 0 to 2 percent slopes (CaA).—This soil is on till plains in the central and northern parts of the county. In a few areas the plow layer is loam or sandy loam rather than fine sandy loam. Included in mapping were small areas of gently sloping Capac soils. Also included were small areas of the darker colored and more poorly drained Brookston soils in drainageways and depressions. These Brookston soils dry out more slowly than the surrounding Capac soils.

Excessive wetness early in spring is the main limitation for farming. Farm machinery bogs down, and the growth of roots is restricted unless the water table is lowered. Tile drainage is needed for efficient production of most crops. The soil material is stable, and ditches and tile are easy to maintain.

Nearly all of this soil is intensively farmed. Corn, sugar beets, small grain, and forage crops are grown. (Capability unit IIw–4 (2.5b); woodland suitability group Z)

Capac fine sandy loam, 2 to 6 percent slopes (CaB).—This soil is on till plains in the central and northern parts of the county. The slopes are uniform, are medium to long, and generally have a gradient of less than 5 percent. In some areas the plow layer is loam or sandy loam rather than fine sandy loam. Included in mapping were areas of moderately eroded Capac soils, mainly where the slope is 5 or 6 percent. In these eroded areas, the plow layer is lighter colored and contains some clay loam plowed up from the subsoil. Also included were areas of the slightly coarser textured Belding soils at slightly higher elevations and of the dark-colored, poorly drained Brookston soils in depressions and drainageways. The included Brookston soils dry out and warm up slowly in spring.

Excessive wetness early in spring is the main limitation for farming. Tile drainage is needed for efficient production of crops. Uneven relief in a few areas makes it difficult to plan complete drainage systems. Random tile and surface ditches are effective in such areas.

Nearly all of this soil is farmed intensively. Corn, sugar beets, small grain, and forage crops are grown. (Capability unit IIw–5 (2.5b); woodland suitability group Z)

Carlisle Series

The Carlisle series is made up of very poorly drained, level or depressional, organic soils that occur on till plains, outwash plains, and moraines. These soils formed in material derived from the remains of woody plants, grasses, and sedges.

In a typical profile, the surface layer is black muck about 14 inches thick. Below this is a 14-inch layer of very dark brown, very friable muck that contains small fragments of partly decomposed wood. At a depth of 28 inches is dark grayish-brown, very friable peaty muck.

Fertility is low; the supplies of phosphorus, potassium, and many micronutrients are inadequate. The available water capacity is very high. Runoff is very slow to ponded. Permeability varies but is commonly rapid. The water table is high unless lowered by artificial drainage.

Typical profile of Carlisle muck:

1—0 to 14 inches, black (10YR 2/1) muck; moderate, medium, granular structure; friable; slightly acid; gradual, wavy boundary.

2—14 to 28 inches, very dark brown (10YR 2/2) muck; moderate, fine, granular structure; very friable; contains many small, partly decomposed wood fragments; slightly acid; gradual, wavy boundary.

3—28 to 44 inches +, dark grayish-brown (10YR 4/2) peaty muck; massive; very friable; slightly acid.

The surface layer is 10 to 24 inches thick. It contains few to many fragments of partly decomposed wood and a few logs up to 2 feet in diameter. The reaction of the profile ranges from medium acid to neutral.

Carlisle soils differ from Houghton soils in containing wood fragments. They lack the substratum of marl that is characteristic of Edwards soils and the substratum of sand that is characteristic of Tawas soils.

Carlisle muck (0 to 1 percent slopes) (Cc).—This soil occurs in depressions on till plains, outwash plains, and moraines throughout the county.

Excessive wetness is the main limitation for farming. Unless the water table is lowered by artificial drainage, farm machinery bogs down and farming operations are hampered. The water table should be controlled at a level low enough to allow adequate room for growth of roots but not so low that the organic material will settle. Some areas lack outlets for drainage. Shortages of phosphorus, potassium, and several micronutrients, including manganese, boron, copper, and zinc, constitute another limitation. Frost damage is a hazard to crops in the lowest areas, and soil blowing is also a hazard if large areas are cultivated.

If this soil is artificially drained, adequately fertilized, and protected against the wind, many short-season, frost-resistant crops can be grown. Most of the larger areas have been drained and are farmed intensively. Vegetables for market are common crops. Small areas are in woods. (Capability unit IIIw–15 (Mc); woodland suitability group J)

Celina Series

The Celina series is made up of moderately well drained, level to gently sloping soils on till plains and low moraines. These soils formed in loamy material.

In a typical profile, the surface layer is dark grayish-brown loam about 8 inches thick. The subsurface layer is brown, friable loam about 4 inches thick. The subsoil,

about 12 inches thick, is yellowish-brown, firm clay loam mottled in the lower part with grayish brown. Pale-brown, firm, limy heavy loam mottled with grayish brown underlies the subsoil at a depth of about 24 inches.

Fertility is high, the available water capacity is high, runoff is slow to medium, and permeability is moderately slow.

Nearly all areas of these soils are farmed intensively. Corn, small grain, and forage crops are the main crops.

Typical profile of a Celina loam:

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) loam; moderate, medium, granular structure; friable; slightly acid; abrupt, smooth boundary.

A2—8 to 12 inches, brown (10YR 5/3) loam; weak, fine, subangular blocky structure; friable; strongly acid; abrupt, wavy boundary.

B21t—12 to 18 inches, yellowish-brown (10YR 5/6) clay loam; moderate, medium, subangular blocky structure; firm; contains a considerable amount of A2 material on cleavage and ped faces and in root channels; strongly acid; gradual, irregular boundary.

B22t—18 to 24 inches, yellowish-brown (10YR 5/4) clay loam; common, medium, faint, brown (7.5YR 5/4) mottles and few, medium, distinct, grayish-brown (10YR 5/2) mottles; moderate, medium, subangular blocky structure; firm; slightly acid; abrupt, wavy boundary.

C—24 to 42 inches +, pale-brown (10YR 6/3) heavy loam; many, medium, distinct, grayish-brown (10YR 5/2) mottles; moderate, medium, platy structure; firm; calcareous.

In areas not yet farmed, there is a very dark grayish-brown A1 horizon 1 to 3 inches thick. The texture of the upper part of the B horizon is heavy loam in some areas. The depth to mottling ranges from 16 to about 28 inches. The depth to the C horizon ranges from 20 to 40 inches. In a few areas the texture of the C horizon is silt loam or light clay loam. The reaction of the A and B horizons ranges from strongly acid to slightly acid.

Celina soils formed in material similar to that in which Miami soils formed, but they differ from Miami soils in having mottles in the lower part of the B horizon. Celina soils are better drained and less mottled than Conover soils.

Celina loam, 0 to 2 percent slopes (CeA).—This soil is on till plains and low moraines. In some cultivated areas the plow layer contains small amounts of pale-brown loam plowed up from the underlying material, and in some areas the plow layer is sandy loam rather than loam. Included in mapping were small areas of gently sloping Celina loam. Also included were wet spots and small areas of muck.

This soil has no limitations that seriously affect its use for farming.

Nearly all of the acreage is farmed intensively. Corn and small grain are major crops. Alfalfa and other forage crops are grown also. (Capability unit I–1 (2.5a); woodland suitability group D)

Celina loam, 2 to 6 percent slopes (CeB).—This soil is on low moraines. The slopes are uniform and of medium length, and the relief is commonly gently undulating. In some areas the plow layer contains small amounts of yellowish-brown clay loam plowed up from the subsoil, and in some places the plow layer consists of sandy loam rather than loam. Included in mapping were small areas of level Celina loam. Also included were small areas of the darker colored Conover and Brookston soils in low areas and drainageways. These two included soils dry out slowly in spring and after rain.

A moderate erosion hazard is the only significant limitation of this Celina soil.

Nearly all the acreage is farmed intensively. Corn and small grain are the major crops. Alfalfa and other forage crops are grown also. (Capability unit IIe–2 (2.5a); woodland suitability group D)

Celina loam, 2 to 6 percent slopes, moderately eroded (CeB2).—This soil is on low moraines. It has uniform, short to medium-length slopes. In many areas the plow layer contains small amounts of yellowish-brown clay loam plowed up from the subsoil, and in many the plow layer consists of sandy loam rather than loam. The plow layer is less fertile, contains less organic matter, and absorbs less water than the plow layer of uneroded Celina soils. Included in mapping were small areas of Miami soils at slightly higher elevations.

The risk of further erosion is a moderate limitation for farming. Surface crusting and poor tilth are hazards in many areas.

All of this soil is farmed intensively. Corn and small grain are important crops. Alfalfa and other forage crops are grown also. (Capability unit IIe–2 (2.5a); woodland suitability group D)

Ceresco Series

The Ceresco series is made up of somewhat poorly drained, level soils on the flood plains of streams and rivers. These soils formed in water-deposited material of loam, silt loam, and sandy loam texture. They are subject to flooding in spring and after prolonged rain in other seasons.

In a typical profile, the surface layer is very dark grayish-brown sandy loam about 9 inches thick. Below the surface layer is dark grayish-brown, friable to very friable sandy loam mottled with dark yellowish brown, yellowish brown, and gray. This material extends to a depth of 26 inches. It is underlain by strata of yellowish-brown, very friable, limy sandy loam and loamy fine sand.

Fertility is medium, and the available water capacity is medium. Runoff is very slow or ponded. Permeability is moderately rapid. The mottles result from prolonged saturation.

Because of the flood hazard and the somewhat poor drainage, only a few areas of these soils are used for crops. Most remain in woods or are used for pasture. Many tracts have been cut by meandering streams into areas too small to be farmed profitably.

Typical profile of Ceresco loam:

Ap—0 to 9 inches, very dark grayish-brown (10YR 3/2) loam; moderate, fine, granular structure; friable; moderately high organic-matter content; neutral; abrupt, smooth boundary.

C1g—9 to 12 inches, dark grayish-brown (10YR 4/2) sandy loam; common, medium, distinct, dark yellowish-brown (10YR 4/4) mottles; weak, medium, granular structure; friable; neutral; gradual, wavy boundary.

C2g—12 to 26 inches, dark grayish-brown (10YR 4/2) sandy loam; common, medium, distinct, yellowish-brown (10YR 5/6) and gray (10YR 5/1) mottles; massive; very friable; mildly alkaline; gradual, wavy boundary.

IIC3—26 to 42 inches +, yellowish-brown (10YR 5/6) stratified sandy loam and loamy fine sand; common,

medium, faint, dark yellowish-brown (10YR 4/4) and distinct, gray (10YR 5/1) mottles; massive; very friable; calcareous.

In areas not yet cultivated, there is a very dark gray A1 horizon 4 to 6 inches thick. In some areas the color of the Ap horizon is dark grayish brown. Below a depth of 30 inches, the texture is varied; layers of sand, loamy sand, and loam occur within some profiles. The reaction of the A horizon and the upper part of the C horizon is mainly neutral or mildly alkaline.

Ceresco soils formed in material similar to that in which Cohoctah soils formed, but they are better drained and lighter colored than Cohoctah soils. Ceresco soils are finer textured throughout than Algansee soils.

Ceresco loam (0 to 1 percent slopes) (Cf).—This soil occurs on flood plains throughout the county. The surface layer consists of very dark grayish-brown loam or sandy loam. Included in mapping were small areas of Cohoctah soils in old stream channels.

Runoff from the uplands accumulates on this Ceresco soil, and flooding early in spring is a hazard.

Most of the acreage is in woods. Small areas are used for pasture, native hay, and cultivated crops. (Capability unit IIIw–12 (L–2c); woodland suitability group O)

Chelsea Series

The Chelsea series is made up of well-drained, level to moderately steep soils on outwash plains and moraines. These soils formed in medium and coarse sand.

In a typical profile (fig. 9), the surface layer is dark-brown loamy sand about 8 inches thick. The upper 10 inches of the subsoil is yellowish-brown, loose sand. Below this is a 26-inch layer of light yellowish-brown, loose sand. Beginning at a depth of 44 inches is a 40-inch layer that consists of light yellowish-brown, loose sand and dark-brown, very friable loamy sand.

Fertility is very low, and the organic-matter content is low. The available water capacity is low; the supply is generally not adequate for optimum growth of crops through the summer. Permeability is rapid. Runoff is slow to medium, depending on the slope. Soil blowing is a hazard.

Most areas of these soils are idle or are used for native hay and pasture. Large acreages have been planted to pine, and some small areas are used for corn and garden vegetables.

Typical profile of a Chelsea loamy sand:

Ap—0 to 8 inches, dark-brown (10YR 3/3) loamy sand; weak, fine, granular structure; very friable; mildly alkaline; abrupt, smooth boundary.

B1—8 to 18 inches, yellowish-brown (10YR 5/6) sand; single grain; loose; medium acid; clear, wavy boundary.

A'2—18 to 44 inches, light yellowish-brown (10YR 6/4) sand; single grain; loose; medium acid; abrupt, wavy boundary.

A'2&B't—44 to 84 inches +, dark-brown (7.5YR 4/4) loamy sand, which represents the B't horizons; light yellowish-brown (10YR 6/4) sand, which represents the A'2 horizons; B't horizons occur as discontinuous bands 1/16 inch to 1 inch thick separated by A'2 horizons 1 inch to 6 inches thick; B't material is massive and very friable; A'2 material is single grain and loose; medium acid.

In areas not yet farmed, there is a very dark grayish-brown A1 horizon 1 to 3 inches thick and a light-gray A1 horizon 1 to 4 inches thick. The color of the B1 horizon ranges to dark brown, and the thickness of this horizon from 4 to 14 inches. The color of the B't horizon ranges to yellowish brown. The first B't layer is at a depth of 40 to 60 inches. The reaction of the A and B horizons ranges from medium acid to mildly alkaline.

Chelsea soils have a slightly coarser textured profile than Montcalm soils. They are better drained than Tedrow soils and lack the mottles that are characteristic of Tedrow soils.

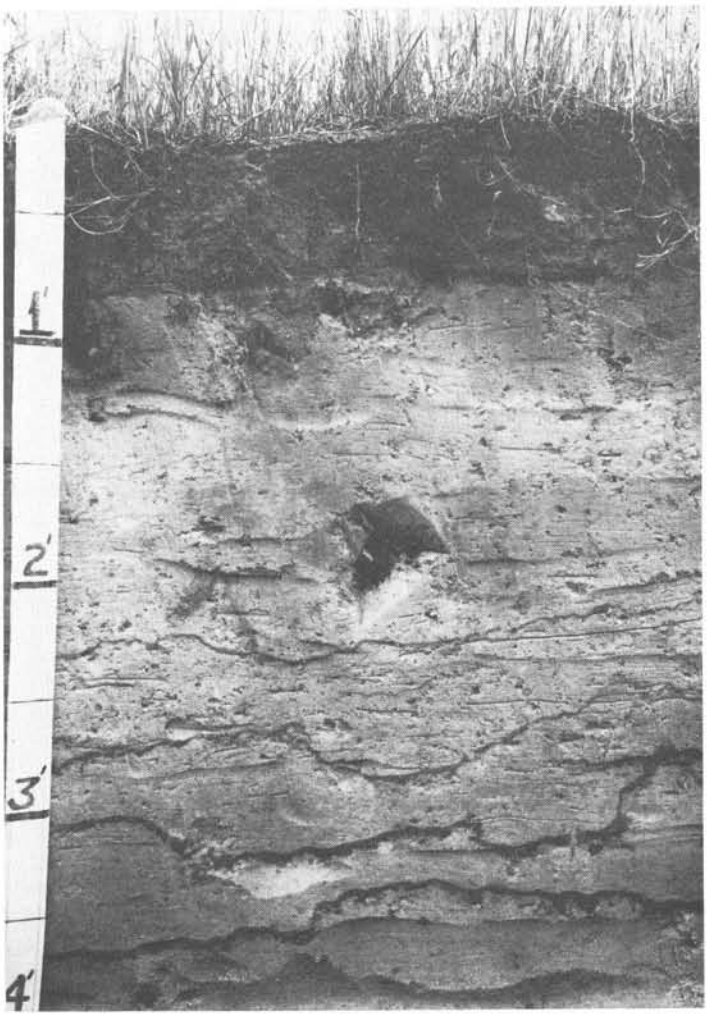

Figure 9.—**Profile of a Chelsea loamy sand. Numbers on tape indicate depth in feet.**

Chelsea loamy sand, 0 to 6 percent slopes (ChB).—This soil is on broad outwash plains. The plow layer is dark brown or dark grayish brown. Wet depressions and drainageways are included in some of the areas mapped.

Permeability is rapid, and the available water capacity is low. The result is a shortage of moisture during most of the growing season. This lack of moisture is the main limitation.

Most of this soil is idle or is used for native hay or pasture. Large acreages have been planted to pine, and small areas are used for corn and garden vegetables. (Capability unit IVs–4 (5a); woodland suitability group E)

Chelsea loamy sandy, 6 to 12 percent slopes (ChC).—This soil is on moraines. The slopes are short and irregular. The surface layer is dark brown or dark grayish

brown; where organic matter has accumulated, the uppermost 4 or 5 inches is very dark grayish brown to very dark brown.

The slope and a shortage of moisture make this soil unsuitable for cultivated crops and limit its use for improved pasture. Enough water is available for trees.

Most of the acreage is in woods or brush. Most cleared areas are in native pasture or native hay. Reforesting of abandoned areas is a desirable practice. (Capability unit VIs–1 (5a); woodland suitability group E)

Chelsea loamy sand, 12 to 18 percent slopes (ChD).—This soil is on moraines. It has a dark grayish-brown surface layer. The slopes are short and irregular. Included in mapping were more nearly level areas on ridges, spurs, and knolls, and steeper areas adjacent to large drainageways.

The slope and a shortage of moisture make this soil unsuitable for cultivated crops and limit its use for hay and improved pasture. The slope and the sandy texture make the use of farm machinery difficult. Enough water is available for trees.

Much of this soil is in woods. Small areas are in brush. Permanent vegetation should be maintained. (Capability unit VIIs–1 (5a); woodland suitability group E)

Cohoctah Series

The Cohoctah series is made up of poorly drained, level soils on flood plains, mainly along the Flint River in the northern part of the county. These soils formed in stratified sandy loam, heavy loamy fine sand, and silt loam material deposited by water. They are flooded frequently in spring and after prolonged rain in other seasons.

In a typical profile, the surface layer is very dark gray loam about 8 inches thick. The subsoil, about 4 inches thick, is grayish-brown, very friable fine sandy loam mottled with yellowish brown. The upper 16 inches of underlying material consists of light brownish-gray, friable fine sandy loam mottled with dark yellowish brown. Below this is gray, loose heavy loamy fine sand mottled with light yellowish brown and dark yellowish brown.

Fertility is medium, and the available water capacity is medium. Runoff is very slow. Permeability is moderate to moderately rapid. The gray color is a result of prolonged saturation.

Because of the flood hazard and the high water table, these soils are not generally used for crops. Woodland, wildlife habitat, and recreation are the main uses. At present the vegetation consists of mixed hardwoods, chiefly elm, soft maple, and swamp white oak. Many tracts have been cut by meandering streams into areas too small to be farmed profitably.

Typical profile of Cohoctah loam:

A1—0 to 8 inches, very dark gray (10YR 3/1) loam; moderate, fine, granular structure; friable; neutral; abrupt, wavy boundary.

B2g—8 to 12 inches, grayish-brown (10YR 5/2) fine sandy loam; many, medium, distinct, yellowish-brown (10YR 5/6) mottles; weak, fine, granular structure; very friable; mildly alkaline; gradual, wavy boundary.

C1g—12 to 28 inches, light brownish-gray (10YR 6/2) fine sandy loam; common, medium, distinct, dark yellowish-brown (10YR 4/4) mottles; weak, medium, subangular blocky structure; friable; contains thin strata of dark-gray (10YR 4/1) silt; mildly alkaline; gradual, wavy boundary.

C2g—28 to 50 inches +, gray (10YR 6/1) heavy loamy fine sand; few, medium, distinct, light yellowish-brown (10YR 6/4) and few, fine, distinct, dark yellowish-brown (10YR 4/4) mottles; single grain; loose; mildly alkaline.

In some areas the color of the A horizon is very dark brown. The texture of the C horizon varies considerably within short distances. In some profiles the C horizon contains thin layers of loam and silt loam. The reaction, to a depth of 28 inches, ranges from slightly acid to mildly alkaline.

Cohoctah soils are more poorly drained and grayer than Ceresco soils. They are in the same drainage class as the finer textured Sloan soils. Cohoctah soils have a finer textured profile than Glendora soils.

Cohoctah loam (0 to 1 percent slopes) (Cm).—This soil is on flood plains. In a few areas the surface layer is sandy loam or very fine sandy loam.

The use of this soil is limited by a hazard of flooding early in spring.

Most of the acreage is in woods. Small areas are used for pasture or for native hay. (Capability unit IIIw–12 (L–2c); woodland suitability group O)

Colwood Series

This series is made up of poorly drained, level or depressional soils on outwash plains and lake plains. These soils formed in stratified silt, fine sand, and very fine sand deposited by water.

In a typical profile, the surface layer is very dark gray loam about 11 inches thick. The upper 7 inches of the subsoil is light brownish-gray, firm heavy loam mottled with yellowish brown, and the lower 14 inches is light brownish-gray, firm light silty clay loam mottled with yellowish brown. Below the subsoil, at a depth of about 32 inches, is gray, friable, limy, stratified silt loam, silt, fine sand, and very fine sand mottled with yellowish brown.

Fertility is high, and the available water capacity is high. Runoff is very slow to ponded. Permeability is moderate to moderately slow. Many areas receive runoff from adjacent higher soils. The gray color of the subsoil is a result of prolonged saturation.

If drained, these soils are suited to corn and other crops. Generally, they are not suitable for farming unless drained.

Typical profile of Colwood loam:

Ap—0 to 9 inches, very dark gray (10YR 3/1) loam; moderate, medium, granular structure; friable; neutral; abrupt, smooth boundary.

A1—9 to 11 inches, very dark brown (10YR 2/2) loam; moderate, coarse, granular structure; friable; neutral; gradual, wavy boundary.

B21g—11 to 18 inches, light brownish-gray (2.5Y 6/2) heavy loam; few, coarse, distinct, yellowish-brown (10YR 5/8) mottles; moderate, medium, subangular blocky structure; firm; coatings of very dark brown (10YR 2/2) on ped faces; neutral; gradual, wavy boundary.

B22tg—18 to 32 inches, light brownish-gray (2.5Y 6/2) light silty clay loam; many, coarse, distinct, yellowish-brown (10YR 5/6) mottles; moderate, medium, subangular blocky structure; firm; thin clay films on some peds; mildly alkaline; abrupt, smooth boundary.

IIC1g—32 to 39 inches, gray (10YR 5/1), stratified silt, fine sand, and silt loam; few, coarse, distinct, yellowish-brown (10YR 5/8) mottles; massive; friable; calcareous; abrupt, smooth boundary.

IIIC2g—39 to 48 inches +, gray (10YR 5/1), stratified silt, fine sand, and very fine sand; massive; friable; calcareous.

In undisturbed areas, there is a 2- to 6-inch layer of muck at the surface. The color of the 6- to 10-inch Ap horizon is black or very dark grayish brown in some areas. The texture of the B horizon ranges from light silty clay loam to loam, heavy fine sandy loam, or light sandy clay loam, depending on the sequence of layers in the water-deposited material. The thickness of the A and B horizons combined ranges from 20 to about 40 inches. The reaction of the A and B horizons ranges from slightly acid to mildly alkaline.

Colwood soils are more poorly drained and have a grayer B horizon than Kibbie soils. They have a finer textured subsoil than either Pinconning or Brevort soils.

Colwood loam (0 to 1 percent slopes) (Co).—This soil is on lake plains and outwash plains. In some areas there is a thin layer of muck at the surface, and in some the surface layer is silt loam or fine sandy loam.

Generally, this soil is too wet for crops unless it is drained artificially. The wetness interferes with the use of farm machinery, delays planting, and hampers other farming operations. Drainage is difficult because ditches and tile trenches cave in readily. Installing tile is easiest during periods of dry weather. Special blinding material is needed to keep soil material from flowing into tile. Frost early in fall is a hazard to crops.

If drained, this soil is well suited to corn and other crops. (Capability unit IIw–4 (2.5c); woodland suitability group W)

Conover Series

The Conover series is made up of somewhat poorly drained, level to undulating soils on till plains in the southern part of the county. These soils formed in loam or light clay loam material and were affected during formation by a fluctuating high water table.

In a typical profile, the surface layer is very dark grayish-brown loam about 8 inches thick. The 3-inch subsurface layer is pale-brown, friable loam mottled with yellowish brown. The subsoil, about 17 inches thick, consists of pale-brown and yellowish-brown, firm clay loam mottled with dark brown, light brownish gray, and grayish brown. Below the subsoil, at a depth of about 28 inches, is brown, firm, limy loam mottled with grayish brown and yellowish brown.

Fertility is high. The available water capacity is high; the supply is usually adequate for optimum growth of crops. Runoff is slow to ponded, and permeability is moderately slow. The water table is high in spring and after rain in other seasons. After these soils have been drained and have dried out, they are easy to work and to keep in good tilth.

Most of the acreage has been drained and is farmed. Corn, small grain, sugar beets, and forage crops are suitable crops.

Typical profile of a Conover loam:

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) loam; moderate, fine, granular structure; friable; neutral; abrupt, smooth boundary.

A2—8 to 11 inches, pale-brown (10YR 6/3) loam; few, fine, distinct, yellowish-brown (10YR 5/4) mottles; moderate, fine, subangular blocky structure; friable; medium acid; abrupt, wavy boundary.

B21t—11 to 14 inches, pale-brown (10YR 6/3) light clay loam; many, medium, distinct, dark-brown (10YR 4/3) and light brownish-gray (10YR 6/2) mottles; moderate, medium, subangular blocky structure; firm; thin clay films on numerous peds; slightly acid; clear, wavy boundary.

B22t—14 to 28 inches, yellowish-brown (10YR 5/4) clay loam; many, medium, distinct, grayish-brown (10YR 5/2) mottles and coatings on ped surfaces; strong, medium, subangular blocky structure; firm; medium clay films on most peds; neutral; abrupt, wavy boundary.

C—28 to 42 inches +, brown (10YR 5/3) loam; many, medium, faint, grayish-brown (10YR 5/2) and many, medium, distinct, yellowish-brown (10YR 5/8) mottles; weak, medium, subangular blocky structure; firm; calcareous.

In areas not yet farmed, there is a very dark gray or very dark grayish-brown A1 horizon 2 to 5 inches thick. The color of the plow layer in some areas is very dark gray instead of very dark grayish brown, and the thickness of this layer ranges from 6 to 9 inches. The depth to mottling ranges from 20 to about 40 inches. In a few areas the texture of the underlying material is light clay loam or silt loam. The reaction of the A and B horizons ranges from medium acid to neutral.

Conover soils formed in material similar to that in which Miami and Celina soils formed. They are more poorly drained than either Celina soils, which are less mottled, or Miami soils, which lack mottles. Conover soils are less poorly drained and less gray than Brookston soils.

Conover loam, 0 to 2 percent slopes (CvA).—This soil is on till plains. In a few areas the surface texture is silt loam or sandy loam. The surrounding topography is gently undulating, and small areas of gently sloping Conover soils were included with this level soil in mapping. Also included were areas of Brookston soils in narrow drainageways and depressions. These included Brookston soils stay wet longer than the surrounding Conover soil.

This Conover soil receives runoff from adjacent higher soils. The water table is seasonally high, and runoff is slow. Excessive wetness early in spring is a limitation for farming. Tile drains and shallow waterways are needed to remove excess water. The soil material is stable, so drainage ditches and tile trenches are not likely to cave in. If tilled when wet, this soil puddles, loses its granular structure, and dries out hard and cloddy, but after it has been drained and has dried out, it is easy to work and to keep in good tilth. Farm machinery is likely to bog down when the soil is wet.

Most of this soil is farmed intensively. Corn, sugar beets, small grain, and forage crops are suitable crops. (Capability unit IIw–4 (2.5b); woodland suitability group Z)

Conover loam, 2 to 6 percent slopes (CvB).—This soil is on till plains in the southern part of the county. It has medium-length to long slopes, predominantly of 4 to 6 percent. Small areas of level Conover soils were included in mapping. Also included were small areas of moderately eroded Conover soils on the crests of 5 to 6 percent slopes. In some of these eroded areas, the plow layer is grayish brown and contains small amounts of yellowish-brown clay loam plowed up from the subsoil; in others, the surface layer is sandy loam. Included areas of Brookston soils occupy drainageways; these soils stay wet longer than the surrounding Conover soils.

Artificial drainage is needed to remove excess water. Undulating relief makes it difficult to plan a complete drainage system for some areas, but random tile and

surface drains are effective in such places. If tilled when wet, the soil puddles, loses its granular structure, and dries out hard and cloddy, but after it has been drained and has dried out, it is easy to work and to keep in good tilth.

Most of this soil is farmed intensively. Corn, sugar beets, small grain, and forage crops are suitable crops. (Capability unit IIw–5 (2.5b); woodland suitability group Z)

Del Rey Series

The Del Rey series is made up of somewhat poorly drained, level to undulating soils on lake plains. These soils formed in stratified material that consisted mainly of silty clay loam and clay loam but included thin layers of silt, fine sand, and clay.

In a typical profile, the surface layer is dark grayish-brown silt loam about 8 inches thick. The subsoil, about 16 inches thick, consists of yellowish-brown and brown, firm silty clay loam mottled with dark grayish brown and pale brown. The underlying material, at a depth of 24 inches, is made up of strata of brown, firm silty clay loam and friable silt and thin layers of brown, friable very fine sand.

Fertility is high, and the available water capacity is high. Permeability is moderately slow. Runoff is slow, and water often ponds in the lowest spots. Runoff from adjacent higher soils accumulates on these soils, and the water table is high in spring and during wet weather in other seasons. These soils warm up and dry out slowly in spring unless artificially drained.

If drained, these soils are suited to crops. Most areas are farmed. Corn, sugar beets, and forage crops are the main crops.

Typical profile of a Del Rey silt loam:

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) silt loam; moderate, coarse, granular structure; friable; neutral; abrupt, wavy boundary.

B21t—8 to 12 inches, yellowish-brown (10YR 5/4) silty clay loam; few, medium, distinct, dark grayish-brown (10YR 4/2) and pale-brown (10YR 6/3) mottles; moderate, medium, angular blocky structure; firm; mildly alkaline; clear, wavy boundary.

B22t—12 to 24 inches, brown (10YR 5/3) heavy silty clay loam; common, medium, distinct, dark grayish-brown (10YR 4/2) mottles and coatings on ped surfaces; contains thin layers of silt; moderate, medium, prismatic structure breaking to strong, medium, angular blocky; firm; mildly alkaline; abrupt, wavy boundary.

IIC—24 to 42 inches +, 3- to 6-inch strata of brown (10YR 5/3) silty clay loam and silt and thin layers of brown (10YR 5/3) very fine sand; the silty clay loam, which is dominant, is firm and has strong, medium, subangular blocky structure; the silt and very fine sand are friable and have weak, thin, platy structure; calcareous.

In some areas the color of the Ap horizon is very dark grayish brown. A pale-brown or light brownish-gray A2 horizon 1 to 3 inches thick underlies the Ap horizon in some areas. The texture of the B horizon in some profiles is light silty clay, and in some the B and C horizons include layers of sandy loam and clay loam. The depth to the IIC horizon ranges from 20 to about 34 inches. The reaction of the A and B horizons is dominantly neutral or mildly alkaline but ranges to slightly acid.

Del Rey soils are more poorly drained and more mottled than Morley soils and are better drained and less gray than Lenawee soils. They have a stratified C horizon, more variable in texture than the C horizon of Blount soils.

Del Rey silt loam, 0 to 2 percent slopes (DrA).—This soil is on lake plains in the central part of the county. In places the plow layer is very dark grayish brown rather than dark grayish brown. Included with this level soil in mapping were small areas of gently sloping Del Rey soils. Also included were small areas of Lenawee soils in narrow drainageways and small depressions. These included Lenawee soils stay wet longer than the adjacent Del Rey soil.

Excessive wetness and poor to fair tilth are the main limitations for farming.

If drained, this soil is suited to corn, sugar beets, and forage crops. Most of it is drained and intensively farmed. (Capability unit IIw–2 (1.5b); woodland suitability group Z)

Del Rey silt loam, 2 to 6 percent slopes (DrB).—This soil is on lake plains in the central part of the county. Small areas of level Del Rey soils are included in the areas mapped. Also included are spots of moderately eroded Del Rey soils, in which part of the yellowish-brown layer of the subsoil is mixed into the plow layer.

Excessive wetness and poor to fair tilth are the main limitations for farming. Some areas have undulating relief, which makes it difficult to lay out a complete drainage system.

If drained, this soil is suited to corn, sugar beets, and forage crops. Most of it is drained and intensively farmed. (Capability unit IIw–3 (1.5b); woodland suitability group Z)

Dryden Series

The Dryden series is made up of moderately well drained, level to gently sloping soils on till plains and low moraines in the southern part of the county. These soils formed in limy material of sandy loam texture.

In a typical profile, the surface layer is dark grayish-brown sandy loam about 8 inches thick, and the 4-inch subsurface layer is brown, friable sandy loam. The subsoil is about 22 inches thick. The upper 9 inches is brown, firm heavy loam, and the lower 13 inches is dark yellowish-brown, firm sandy clay loam mottled with brown. The underlying material, at a depth of about 34 inches, is grayish-brown, friable, limy sandy loam mottled with yellowish brown.

Fertility is moderate, the available water capacity is moderate, permeability is moderate, and runoff is slow. These soils are easy to work. They dry out quickly and so are ready for tillage early in spring.

Most areas of these soils are farmed. Corn, oats, wheat, hay, and potatoes are the common crops. Forage crops can be grown also.

Typical profile of a Dryden sandy loam:

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) sandy loam; weak, fine, granular structure; friable; slightly acid; abrupt, smooth boundary.

A2—8 to 12 inches, brown (10YR 5/3) sandy loam; moderate, medium, granular structure; friable; medium acid; clear, smooth boundary.

B21t—12 to 21 inches, brown (10YR 5/3) heavy loam; moderate, medium, subangular blocky structure; firm; slightly acid; gradual, wavy boundary.

B22t—21 to 34 inches, dark yellowish-brown (10YR 4/4) sandy clay loam; common, medium, distinct, brown

(10YR 5/3) mottles; moderate, medium, subangular blocky structure; firm; thin clay films on some peds; slightly acid; gradual, wavy boundary.
C—34 to 42 inches +, grayish-brown (10YR 5/2) sandy loam; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; massive; friable; calcareous.

In areas not yet farmed, there is a very dark grayish-brown A1 horizon 2 to 4 inches thick. The depth to mottling ranges from 16 to about 30 inches. In some profiles the texture of the lower part of the B horizon is heavy sandy loam. The depth to the C horizon ranges from 20 to about 40 inches. The reaction of the A and B horizons is medium acid to slightly acid.

Dryden soils formed in material similar to that in which Lapeer and Locke soils formed. Dryden soils differ from Lapeer soils in having a mottled subsoil. They are better drained and less mottled than Locke soils. They have a coarser textured C horizon than Celina soils.

Dryden sandy loam, 0 to 2 percent slopes (DyA).—This soil is on till plains and low moraines, mainly in the southern part of the county. The plow layer is dark grayish brown, and in a few areas it is loam rather than sandy loam. In areas that are intensively farmed, the plow layer contains a little grayish-brown sandy loam plowed up from the underlying material. Included in mapping were a few areas of gently sloping Dryden soils. Also included were areas of darker colored Locke soils in depressions and narrow drainageways. These included Locke soils stay wet longer than the surrounding Dryden soil.

Water erosion is not a hazard, but soil blowing is likely if large areas are left bare of vegetation. In dry years the moisture supply is inadequate for crops.

Nearly all of this soil is farmed. Small grain, corn, and alfalfa are common crops. (Capability unit IIs–2 (3a); woodland suitability group U)

Dryden sandy loam, 2 to 6 percent slopes (DyB).—This soil is on till plains and low moraines, mainly in the southern part of the county. The slopes are generally uniform and are predominantly between 2 and 4 percent in gradient. In a few areas the plow layer is loam rather than sandy loam, and in a few areas it contains a little brown loam plowed up from the subsoil. Included in mapping were small areas of level Dryden sandy loam. Also included were areas of the darker colored Locke soils in depressions and drainageways.

Erosion is a hazard if this Dryden soil is farmed, and in dry years the supply of available water is inadequate for crops.

Most of this soil is cultivated. Small grain, corn, and alfalfa are grown. (Capability unit IIe–3 (3a); woodland suitability group U)

Edwards Series

This series is made up of very poorly drained, level to depressional, organic soils on till plains, lake plains, and moraines. These soils formed in organic material underlain at a depth of 12 to 42 inches with marl. The organic material was derived from woody plants, grasses, and sedges.

In a typical profile, the surface layer is very dark grayish-brown muck about 18 inches thick. Below this is a 12-inch layer of very dark brown muck stratified with thin layers of bluish-gray marl. This layer contains small snail shells. At a depth of about 30 inches is gray marl that contains thin layers of sand and shale.

Fertility is generally low. Permeability is rapid in the organic layers and variable in the underlying marl. The water table is at the surface unless lowered by artificial drainage, and in some areas the marl is so slowly permeable that water does not move downward and the organic layers are saturated even after artificial drainage. Runoff is very slow to ponded.

Most areas of these soils are in woods or native pasture. Truck crops are grown in drained areas that are next to areas of deeper organic soils.

Typical profile of Edwards muck:

1—0 to 18 inches, very dark grayish-brown (10YR 3/2) muck; moderate, coarse, granular structure; very friable; mildly alkaline; abrupt, smooth boundary.
2—18 to 30 inches, very dark brown (10YR 2/2) muck; thin layers of bluish-gray (5G 6/1) marl; massive; contains some shells; calcareous; abrupt, smooth boundary.
IIC—30 to 54 inches +, gray (5Y 6/1) marl; contains thin layers of sand and shells; massive; calcareous.

The color of the surface layer is very dark grayish brown or black. The reaction of the organic layers is mainly alkaline.

Edwards soils have a marl substratum, in contrast with Linwood soils, which have a silt loam substratum. Edwards soils have a thinner layer of organic material than either Carlisle or Houghton soils.

Edwards muck (0 to 1 percent slopes) (Ed).—This soil occurs in swampy areas throughout the county. In some places the surface layer is black rather than very dark grayish brown.

Excessive wetness, a frost hazard, high alkalinity, and inadequate depth of the organic layers limit the use of this soil for crops. Drainage systems are hard to install and maintain because the marl is so near the surface and because outlets are scarce. Drainage, if effective, is likely to be followed by settling of the organic material. The alkalinity results in a shortage of plant nutrients. Soil blowing is a hazard if cultivated crops are grown.

Most of the acreage is in woods and native pasture. Very little is cultivated. (Capability unit IVw–6 (M/mc); woodland suitability group J)

Fabius Series

The Fabius series is made up of somewhat poorly drained, level to undulating soils on outwash plains and lake plains. These soils formed in water-deposited material that consisted of 10 to 24 inches of loamy sand and sandy loam underlain with stratified sand and gravel. They were influenced during formation by a fluctuating high water table.

In a typical profile, the surface layer is very dark grayish-brown sandy loam about 7 inches thick. The subsurface layer, about 3 inches thick, is grayish-brown, very friable sandy loam. The subsoil is about 8 inches thick. The upper 2 inches is yellowish-brown, friable heavy sandy loam and the lower 6 inches is yellowish-brown, firm gravelly sandy clay loam. Both of these layers have dark yellowish-brown and grayish-brown mottles. At a depth of about 18 inches is pale-brown, loose, limy, stratified coarse sand and gravel.

Fertility is low to moderate, and the available water capacity is moderately low. The water table is high in spring and during wet weather in other seasons. Permeability is moderately rapid, except at the times when the

water table is high. If the water table is lowered artificially, these soils dry out quickly and tend to be droughty. Soil blowing is a hazard if large areas are cultivated.

If drained, these soils are suited to the crops commonly grown in the county.

Typical profile of a Fabius sandy loam:

Ap—0 to 7 inches, very dark grayish-brown (10YR 3/2) sandy loam; weak, fine, granular structure; very friable; moderately high in organic-matter content; slightly acid; abrupt, wavy boundary.

A2—7 to 10 inches, grayish-brown (10YR 5/2) sandy loam; weak, fine, granular structure; very friable; slightly acid; clear, wavy boundary.

B21t—10 to 12 inches, yellowish-brown (10YR 5/4) heavy sandy loam; common, medium, distinct, dark yellowish-brown (10YR 4/4) and grayish-brown (10YR 5/2) mottles; weak, medium, subangular blocky structure; friable; slightly acid; clear, wavy boundary.

B22t—12 to 18 inches, yellowish-brown (10YR 5/6) gravelly sandy clay loam; common, medium, distinct, dark yellowish-brown (10YR 4/4) and grayish-brown (10YR 5/2) mottles; weak, medium, subangular blocky structure; firm; slightly acid; abrupt, wavy boundary.

IIC—18 to 42 inches +, pale-brown (10YR 6/3) stratified coarse sand and gravel; single grain; loose; calcareous.

In areas not yet farmed, there is a very dark grayish-brown or very dark brown A1 horizon 5 to 7 inches thick. The color of the Ap horizon is very dark brown in some areas, and the thickness of that horizon ranges from 6 to 9 inches. In a few areas the texture of the B horizon is clay loam or gravelly clay loam. The reaction of the A and B horizons ranges from slightly acid to neutral.

Fabius soils have a thinner subsoil than Wasepi soils and are shallower to sand and gravel. They are less poorly drained and less gray than Mussey soils.

In this county Fabius soils were mapped in complexes with Wasepi soils.

Fabius-Wasepi sandy loams, 0 to 2 percent slopes (FaA).—This complex occurs on lake plains and outwash plains throughout the county. In some places the plow layer contains a little gravel.

This mapping unit is made up of about equal acreages of Fabius sandy loam and Wasepi sandy loam, which occur together in such complex patterns that they cannot be shown separately on the soil map. The two soils are similar in texture and in drainage characteristics, and both are underlain with stratified sand and gravel, but in Fabius sandy loam the depth to the underlying material is less than 24 inches, and in Wasepi sandy loam it is 24 to 42 inches. Included with these soils in mapping were areas of the poorly drained Gilford soils in drainageways. These included soils stay wet longer than the surrounding Fabius and Wasepi soils.

Excessive wetness and low to moderate fertility are the major limitations for farming. Drainage can be improved by the use of tile, open ditches, and surface drains. It is advisable to install tile and to dig ditches during dry weather, because ditches and trenches cave in readily when the soils are wet. Some areas lack outlets for drainage. Straw or other blinding material helps to keep soil material from flowing into and plugging tile.

Corn and forage crops are commonly grown in drained areas of this complex, and native pasture plants in undrained areas. (Capability unit IIIw–5 (4b); woodland suitability group G)

Fabius-Wasepi sandy loams, 2 to 6 percent slopes (FaB).—This complex occurs on lake plains and outwash plains throughout the county. In some places the plow layer contains a little yellowish-brown sandy clay loam plowed up from the subsoil.

About 60 percent of this mapping unit is Fabius sandy loam, which occurs with Wasepi sandy loam in such complex patterns that the two soils cannot be shown separately on the soil map. The two soils are similar in texture and in drainage characteristics, and both are underlain with stratified sand and gravel, but in Fabius sandy loam the depth to the underlying material is less than 24 inches, and in Wasepi sandy loam it is 24 to 42 inches.

Excessive wetness and low to moderate fertility are the major limitations for farming. Installing a complete drainage system is difficult, because of undulating relief, but random tile and surface drains can be used to remove water from the lowest and wettest areas. Because trenches cave in readily when the soils are wet, it is advisable to install tile during dry weather. Straw and other blinding material help to keep soil material from flowing into and plugging the tile.

Corn and forage crops are grown in drained areas of this complex, and native pasture plants in undrained areas. (Capability unit IIIw–5 (4b); woodland suitability group G)

Fox Series

The Fox series is made up of well-drained, level to sloping soils on outwash plains and low moraines. These soils formed in loamy material 24 to 42 inches thick over stratified gravel and sand.

In a typical profile, the surface layer is dark grayish-brown sandy loam about 8 inches thick. The subsurface layer, about 4 inches thick, is yellowish-brown, very friable gravelly sandy loam. The subsoil is about 18 inches thick. The upper 14 inches is dark reddish-brown, firm gravelly clay loam, and the lower 4 inches is dark-brown, friable heavy gravelly sandy loam. The substratum, at a depth of about 30 inches, is light brownish-gray, loose, limy, stratified gravel and coarse sand.

Fertility is moderate, the available water capacity is moderate, permeability is moderate, and runoff is slow to medium, depending on the slope. These soils dry out and warm up readily, and they are ready for tillage early in spring. They can be tilled easily over a wide range of moisture content. Crusting is not generally a hazard if tillage is kept to a minimum and the organic-matter content is maintained.

Corn, oats, wheat, and hay are the common crops. Forage crops can be grown also.

Typical profile of a Fox sandy loam:

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) sandy loam; weak, medium, granular structure; friable; neutral; abrupt, smooth boundary.

A2—8 to 12 inches, yellowish-brown (10YR 5/4) gravelly sandy loam; weak, fine, granular structure; very friable; slightly acid; abrupt, wavy boundary.

B21t—12 to 26 inches, dark reddish-brown (5YR 3/3) gravelly clay loam; moderate, coarse, subangular blocky structure; firm; medium acid; clear, wavy boundary.

B22t—26 to 30 inches, dark-brown (10YR 4/3) heavy gravelly sandy loam; weak, medium, subangular blocky

structure; friable; slightly acid; abrupt, irregular boundary.

IIC—30 to 42 inches +, light brownish-gray (10YR 6/2) stratified gravel and coarse sand; single grain; loose; calcareous.

In areas not yet farmed, there is a very dark grayish-brown A1 horizon 1 to 3 inches thick. In some areas the color of the B horizon is dominantly dark brown, and the texture of the B horizon ranges to gravelly sandy clay loam or clay loam. Cobblestones occur in the lower part of the B horizon and in the C horizon in some places. The reaction of the A and B horizons ranges from medium acid to neutral.

Fox soils have a thicker, finer textured B horizon than either Boyer or Oshtemo soils. They are less deep to the IIC horizon than Oshtemo soils. They are better drained than Matherton soils and lack the mottling that is characteristic of Matherton soils. Fox soils differ from Miami soils in having more gravel and sand in the B horizon and in being underlain with sand and gravel.

Fox sandy loam, 0 to 2 percent slopes (FoA).—This soil occurs on outwash plains throughout the county. The plow layer contains a considerable amount of fine gravel, and in a few areas it has a loam instead of a sandy loam texture. Included in mapping were a few areas of gently sloping Fox sandy loam.

The available water capacity is only moderate, and in some years the moisture supply is not adequate for crops. Water erosion is not a hazard, because water is absorbed readily and little of it runs off. Soil blowing is a hazard if large areas are left bare of vegetation.

This soil can be farmed intensively without damage if fertility is maintained and the structure preserved. Most of the acreage is cultivated. Small grain, corn, and alfalfa are common crops. (Capability unit IIs–2 (3a); woodland suitability group U)

Fox sandy loam, 2 to 6 percent slopes (FoB).—This soil occurs on outwash plains and low moraines throughout the county. The slopes are uniform and are short to medium in length. In a few areas the surface layer is loam rather than sandy loam. Included in mapping were small moderately eroded areas in which the surface layer is brown or yellowish brown.

Runoff is medium, and the hazard of water erosion is moderate. The supply of water available to crops is somewhat limited in dry periods.

Most of this soil is cultivated. Small grain and corn are important crops. (Capability unit IIe–3 (3a); woodland suitability group U)

Fox sandy loam, 6 to 12 percent slopes, moderately eroded (FoC2).—This soil is on low moraines. The slopes are short and irregular. About half the original surface layer has been removed by erosion. The plow layer is brown or yellowish brown, and in some areas it contains a little dark reddish-brown gravelly clay loam plowed up from the subsoil. Erosion has impaired fertility, reduced the organic-matter content, and increased runoff. Included in mapping were severely eroded areas in which the dark reddish-brown subsoil is exposed. In these areas the surface crusts when dry, and, consequently, germination of seeds is uneven and stands of plants are poor. Also included were small areas of less sloping Fox soils.

Because of the hazard of further erosion, careful management is needed, especially if row crops are grown frequently. The supply of water available to plants is limited during dry periods.

Nearly all the acreage is farmed. Corn and small grain are the main crops. Small acreages are used for pasture and for forage crops. (Capability unit IIIe–6 (3a); woodland suitability group U)

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Gilford Series

The Gilford series is made up of poorly drained, level soils that occur on lake plains and outwash plains. These soils formed in sandy loam material 24 to 42 inches thick over stratified sand and gravel. They were affected during formation by a high water table.

In a typical profile, the surface layer is black or very dark gray sandy loam about 11 inches thick. The subsoil, about 19 inches thick, is gray, friable to very friable sandy loam mottled with yellowish brown. Below the subsoil, at a depth of about 30 inches, is gray, loose, limy sand, silt, and fine gravel.

Fertility is moderate to low, and the available water capacity is moderate to low. Runoff is slow to very slow. The water table is usually within 12 inches of the surface in spring and in wet weather in other seasons. Permeability is moderately rapid, except when the water table is high. The gray color is a result of prolonged saturation. If the water table is lowered by artificial drainage, the soils tend to be droughty.

The largest areas of these soils are farmed. Corn, small grain, and hay are common crops. The selection of crops depends on the degree of drainage.

Typical profile of Gilford sandy loam:

Ap—0 to 8 inches, black (10YR 2/1) sandy loam; weak, medium, granular structure; very friable; slightly acid; abrupt, smooth boundary.

A1—8 to 11 inches, very dark gray (10YR 3/1) sandy loam; weak, coarse, granular structure; very friable; slightly acid; gradual, wavy boundary.

B21g—11 to 15 inches, gray (10YR 5/1) sandy loam; weak, fine, subangular blocky structure; very friable; very dark gray (10YR 3/1) coatings on peds; slightly acid; clear, wavy boundary.

B22g—15 to 30 inches, gray (10YR 5/1) sandy loam; many, medium, distinct, yellowish-brown (10YR 5/6) mottles; moderate, medium, subangular blocky structure; friable; neutral; gradual, wavy boundary.

IIC1g—30 to 34 inches, gray (10YR 5/1) medium sand with thin lenses of silt and fine sand; single grain; loose; mildly alkaline; gradual, wavy boundary.

IIC2g—34 to 42 inches +, gray (10YR 5/1) coarse sand and a small amount of fine gravel; single grain; loose; calcareous.

In some undisturbed areas there is a 2- to 8-inch layer of muck at the surface. The thickness of the A horizon ranges from 8 to about 13 inches. The thickness of the A and B horizons combined ranges from 24 to about 42 inches. The texture of the C horizon is mainly sand in some areas, and in other areas this horizon consists of stratified sand and gravel. The reaction of the A and B horizons ranges from slightly acid to mildly alkaline.

Gilford soils are more poorly drained and have a grayer B horizon than Wasepi soils. They are finer textured in the uppermost 30 inches than Granby soils and have a coarser textured B horizon than Sebewa soils. Gilford soils have a thicker B horizon and are deeper to sand and gravel than Mussey soils.

Gilford sandy loam (0 to 1 percent slopes) (Gd).—This soil occurs on outwash plains and lake plains throughout the county. In a few areas the plow layer is loamy sand rather than sandy loam. Included in mapping were small areas of Wasepi soils at slightly higher elevations and small areas of Tawas muck in depressions.

Excessive wetness and moderate to low fertility are the main limitations for farming. Drainage is needed for

efficient production of crops. Drainage ditches and tile trenches are likely to cave in when the soil is wet.

The largest areas of this soil are cultivated. Corn and forage crops are the main crops. Smaller areas are in woods. (Capability unit IIIw–6 (4c); woodland suitability group W)

Glendora Series

The Glendora series is made up of poorly drained, level soils on the flood plains of the larger streams and rivers. These soils formed in loamy sand and sand material deposited by floodwater. They are subject to flooding early in spring.

In a typical profile, the surface layer is black loam about 8 inches thick. The subsoil, which is only about 3 inches thick, is dark-gray, very friable loamy sand. To a depth of about 15 inches, the underlying material is dark grayish-brown, loose loamy sand mottled with grayish brown. Below this is grayish-brown, loose, neutral sand mottled with yellowish brown.

Fertility is low, and the available water capacity is low. The water table is at or near the surface in spring and during wet weather in other seasons. Permeability is rapid except when the water table is high. If drained effectively these soils tend to be droughty.

Typical profile of Glendora loam:

Ap—0 to 8 inches, black (10YR 2/1) loam; moderate, medium, granular structure; friable; high organic-matter content; slightly acid; abrupt, smooth boundary.

Bg—8 to 11 inches, dark-gray (10YR 4/1) loamy sand; weak, medium, granular structure; very friable; slightly acid; abrupt, smooth boundary.

C1—11 to 15 inches, dark grayish-brown (10YR 4/2) loamy sand; common, medium, distinct, grayish-brown (10YR 5/2) mottles; single grain; loose; neutral; clear, wavy boundary.

C2—15 to 42 inches +, grayish-brown (10YR 5/2) sand; common, medium, distinct, yellowish-brown (10YR 5/4) mottles; single grain; loose; neutral.

Where the soils are undisturbed, there is a black or very dark brown A horizon 8 to 12 inches thick. Thin layers of silt loam and sandy loam occur below a depth of 15 inches in a few areas. The reaction ranges from slightly acid to neutral.

Glendora soils formed in material similar to that in which Abscota and Algansee soils formed, but Glendora soils are darker colored and more poorly drained than either of the others. They are coarser textured than Cohoctah or Sloan soils.

Glendora loam (0 to 1 percent slopes) (Ge).—This soil occurs on flood plains of rivers and streams throughout the county. The surface layer is black or very dark brown, and in a few areas it is sandy loam rather than loam. Included in mapping were small areas of Algansee soils at slightly higher elevations.

Flooding early in spring, a high water table in undrained areas, and droughtiness in drained areas are the main limitations for farming. Drainage is difficult because of flooding and because of the instability of the subsoil and underlying material.

Most of the acreage is in woods. Small areas are used for pasture, native hay, or corn. (Capability unit IIIw–14 (L–4c); woodland suitability group O)

Granby Series

The Granby series is made up of poorly drained, level or depressional soils on outwash plains and lake plains. These soils formed in medium to coarse sand. They were affected during formation by a high water table.

In a typical profile, the surface layer is very dark brown loamy sand about 10 inches thick. Below the surface layer is a 4-inch layer of light brownish-gray, very friable loamy sand mottled with yellowish brown. At a depth of 14 inches is grayish-brown and light brownish-gray, loose sand mottled with yellowish brown and dark yellowish brown.

Fertility is low, and the available water capacity is low. Runoff is very slow to ponded. The water table is at or near the surface unless lowered by artificial drainage. Permeability is rapid except when the water table is high. If drained effectively, these soils tend to be droughty.

Drained areas are used for crops. Undrained areas are in woods or pasture.

Typical profile of Granby loamy sand:

A1—0 to 10 inches, very dark brown (10YR 2/2) loamy sand; weak, fine, granular structure; very friable; high in organic-matter content; neutral; gradual, irregular boundary.

C1—10 to 14 inches, light brownish-gray (10YR 6/2) loamy sand; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; weak, fine, granular structure; very friable; very dark grayish-brown (10YR 3/2) coatings on sand grains; slightly acid; gradual, wavy boundary.

C2—14 to 22 inches, grayish-brown (10YR 5/2) sand; common, medium, distinct, yellowish-brown (10YR 5/6) and dark yellowish-brown (10YR 4/4) mottles; single grain; loose; neutral; gradual, wavy boundary.

C3—22 to 30 inches, light brownish-gray (10YR 6/2) sand; common, medium, distinct, brownish-yellow (10YR 6/6) mottles; single grain; loose; neutral; gradual, smooth boundary.

C4—30 to 40 inches +, light brownish-gray (10YR 6/2) sand; single grain; loose; neutral.

The color of the A horizon is black in some areas, and the thickness of this horizon ranges from 7 to 14 inches.

Granby soils are more poorly drained and grayer than Tedrow soils. They are coarser textured below the A horizon than either Gilford or Mussey soils.

Granby loamy sand (0 to 1 percent slopes) (Gm).—This soil is on outwash plains and lake plains throughout the county. The plow layer contains a considerable amount of organic matter. Included in mapping were a few areas of muck in wet depressions.

Excessive wetness and low fertility are serious limitations for farming. Crops cannot be grown without artificial drainage, and drainage is difficult because the soil material is unstable and because some areas lack outlets.

Most of the acreage is in woods. The areas farmed are used chiefly for forage crops and native pasture. (Capability unit IVw–4 (5c); woodland suitability group W)

Granby loam (0 to 1 percent slopes) (Gn).—This soil is on outwash plains and lake plains in the northern part of the county. In small areas the plow layer is loamy sand rather than loam.

Excessive wetness and low fertility are the main limitations for farming. Crops cannot be grown without artificial drainage, and drainage is difficult because the soil material is unstable and because some areas lack outlets.

Areas that are adequately drained are used for crops. Undrained areas are in woods or pasture. (Capability unit IVw–4 (5c); woodland suitability group W)

Gravel Pits

Gravel pits (Gr) are numerous and are widely distributed. Nearly all are within areas of Fox, Mancelona, and Boyer soils. Profile features have been destroyed by the removal of sand and gravel. Only the larger pits are delineated on the soil map. (Capability unit VIIIs–1 (Sa); no woodland suitability classification)

Greenwood Series

The Greenwood series is made up of very poorly drained, extremely acid, level to depressional organic soils that occur in glacial drainageways and on moraines. These soils formed in extremely acid material derived mainly from mosses and fibrous sedges. This material was more than 42 inches thick.

In a typical profile, the surface layer is dark grayish-brown sphagnum moss peat about 4 inches thick. The layer below this extends to a depth of 44 inches or more and consists of dark reddish-brown, extremely acid, fibrous peat and undecomposed sedges.

Fertility is low because of shortages of phosphorus, potassium, and many micronutrients. The available water capacity is high. Permeability varies but is generally rapid. Runoff is very slow, and water often ponds in the lowest areas. Artificial drainage can cause the organic matter to settle. Soil blowing and frost damage are hazards.

In Lapeer County, Greenwood soils are mapped only in a complex with Spalding soils. The mapping unit is described under the heading of "Spalding Series."

Typical profile of Greenwood peat:

1—0 to 4 inches, dark grayish-brown (10YR 4/2) sphagnum moss peat; massive; nonsticky; matted root layers; extremely acid; abrupt, smooth boundary.
2—4 to 44 inches +, dark reddish-brown (5YR 3/4) fibrous peat; weak, thick, platy structure; nonsticky; distinct matted layers of undecomposed sedge material; extremely acid.

The uppermost layer is 3 to 6 inches thick. The color of both layers is yellowish brown in some areas.

Greenwood soils are more acid than either Houghton or Carlisle soils. They have a thicker layer of organic material than either Adrian or Tawas soils and are more acid than either.

Gullied Land

Gullied land consists of seriously eroded hilly soils on moraines. Most of the original surface layer and a considerable part of the subsoil has been removed by erosion. There are many shallow gullies and enough deep ones, uncrossable with ordinary farm machinery, to prevent cultivation. In most areas some of the gullies have cut into the limy substratum.

Most areas of Gullied land are now idle or are reverting to woods through natural reseeding.

Gullied land, sandy (Gs).—This mapping unit occurs as small areas on moraines throughout the county. Much of the acreage consisted of Boyer and Spinks soils. All of it is so severely eroded as to be unfit for farming.

Gullied land, sandy, can be used for woods and for wildlife habitat. Most areas are now idle or are reseeding naturally to trees. (Capability unit VIIs–1 (5a); woodland suitability group E)

Gullied land, loamy (Gu).—This mapping unit occurs as small areas on moraines throughout the county. Much of the acreage consisted of McBride, Lapeer, Marlette, and Miami soils. All of it is so severely eroded as to be unfit for farming.

Gullied land, loamy, can be used for woods and for wildlife habitat. Most areas are idle or are reseeding naturally to trees. (Capability unit VIIe–2 (2.5a); woodland suitability group D)

Houghton Series

The Houghton series is made up of very poorly drained, level to depressional soils on outwash plains, till plains, and moraines. These soils formed in material derived from grasses, sedges, weeds, and other nonwoody plants. This organic material was more than 42 inches thick.

In a typical profile, the surface layer is black muck about 10 inches thick. Below this is a layer of dark reddish-brown, friable mucky peat about 17 inches thick. At a depth of about 27 inches is brown, friable muck.

Fertility is low because of shortages of phosphorus, potassium, and many micronutrients. The available water capacity is high. Runoff is very slow, and water ponds in the lowest areas, especially in spring and after rain in other seasons. Permeability varies but is generally rapid. The water table is high unless lowered by artificial drainage. Lowering it too much can cause the organic material to settle.

Typical profile of Houghton muck:

1—0 to 10 inches, black (10YR 2/1) muck; weak, medium, granular structure; very friable; medium acid; abrupt, smooth boundary.
2—10 to 27 inches, dark reddish-brown (5YR 3/2) mucky peat; weak, thin, platy structure; friable; slightly acid; gradual, wavy boundary.
3—27 to 46 inches +, brown (7.5YR 4/4) peat; massive; weak, thin, platy structure; friable; neutral.

In a few areas the color of the surface layer is very dark brown. This layer is 6 to 18 inches thick. In many areas the second layer is muck instead of mucky peat. The thickness of the organic material ranges from 42 inches to many feet. The reaction ranges from medium acid to neutral.

Houghton soils differ from Carlisle soils in lacking woody material. They have neither the marl substratum that is characteristic of Edwards soils nor the sand substratum characteristic of Tawas soils.

Houghton muck (0 to 1 percent slopes) (Ho).—This soil is in level areas or swampy depressions on outwash plains, till plains, and moraines throughout the county. Included in mapping were narrow strips of Tawas and Edwards soils in lakebeds.

Excessive wetness, low fertility, and a hazard of soil blowing limit the use of this Houghton soil for crops. Unless the water table is lowered by artificial drainage, farm machinery bogs down readily and all farming operations are hindered. Drainage has to be controlled, in order not to lower the water table so much that the organic material will settle. Some areas lack outlets for drainage. Soil blowing is a hazard if the surface is left bare (fig. 10). The supplies of phosphorus, potassium,

Figure 10.—Houghton muck, protected from soil blowing by windbreaks. The large open ditch is an outlet for tile drains.

and micronutrients, including manganese, boron, copper, and zinc, are low. Frost damage is a hazard in the lowest areas.

If artificially drained, adequately fertilized, and protected against blowing, this soil can be used for many short-season crops. (Capability unit IIIw–15 (Mc); woodland suitability group J)

Hoytville Series

The Hoytville series is made up of poorly drained, level to depressional soils on till plains. These soils formed in clayey glacial till.

In a typical profile, the surface layer is very dark brown silt loam about 9 inches thick. The subsoil, about 19 inches thick, is gray, very firm clay mottled with yellowish brown and olive brown. The underlying material, at a depth of about 28 inches, is gray, very firm, limy clay mottled with olive brown.

Fertility is high, the available water capacity is high, runoff is very slow to ponded, and permeability is very slow. The water table is at or near the surface in spring. The gray color and mottles in the subsoil and underlying material result from excessive wetness. These soils are slow to warm up and dry out in spring. If farmed when wet, they puddle and then dry out hard and cloddy and with impaired tilth.

Most areas of Hoytville soils have been drained and are intensively farmed. Undrained areas are suitable for water-tolerant forage crops.

Typical profile of Hoytville silt loam:

Ap—0 to 9 inches, very dark brown (10YR 2/2) silt loam; weak, coarse, granular structure; friable; slightly acid; abrupt, irregular boundary.

B21tg—9 to 14 inches, gray (10YR 5/1) clay; many, medium, distinct, yellowish-brown (10YR 5/6) mottles; moderate, medium, prismatic structure breaking to moderate, fine, angular blocky; very firm; Ap material in root channels and coating peds; slightly acid; gradual, wavy boundary.

B22tg—14 to 28 inches, gray (10YR 5/1) clay; many, coarse, distinct, olive-brown (2.5Y 4/4) mottles; strong, medium, angular blocky structure; very firm; neutral; abrupt, wavy boundary.

Cg—28 to 42 inches +, gray (5Y 5/1) clay; few, medium, distinct, olive-brown (2.5Y 4/4) mottles; weak, coarse, angular blocky structure; very firm; calcareous.

In some areas the color of the A horizon is very dark gray. This horizon is 6 to 9 inches thick. The thickness of the A and B horizons combined ranges from 24 to about 40 inches. The texture of the C horizon is clay to heavy clay loam. The reaction of the A and B horizons ranges from slightly acid to mildly alkaline.

Hoytville soils formed in material similar to that in which Nappanee soils formed, but they are darker and grayer in color than Nappanee soils. Hoytville soils have finer textured underlying material than Pewamo soils.

Hoytville silt loam (0 to 1 percent slopes) (Ht).—This soil is on till plains throughout the county. In some areas

the plow layer contains a little gray and yellowish-brown clay plowed up from the subsoil. Included in mapping were areas of Nappanee soils at slightly higher elevations and areas of Willette soils in wet depressions.

This Hoytville soil is hard to work because of poor drainage and a clayey subsoil. Runoff is very slow to ponded. Machinery bogs down when the soil is wet. A combination of tile and open ditches is needed to provide adequate drainage. Water can be removed from depressions by means of shallow waterways. Some areas lack outlets for drainage.

Corn is the crop commonly grown. (Capability unit IIw–2 (1c); woodland suitability group P)

Hoytville silty clay loam (0 to 1 percent slopes) (Hy).—This soil is on till plains throughout the county. The plow layer is very dark gray or dark gray. In some places it contains a little gray and yellowish-brown clay plowed up from the subsoil. Included in mapping were areas of Nappanee soils at slightly higher elevations and of Willette soils in depressions.

This Hoytville soil is hard to work because of poor drainage and a clayey subsoil. Runoff is very slow to ponded, and permeability is restricted. Tilth is poor, and the surface tends to crust. Machinery bogs down when the soil is wet. A combination of tile drains and open ditches is needed to provide adequate drainage. Water can be removed from depressions by means of shallow waterways.

Corn is the crop commonly grown. (Capability unit IIw–2 (1c); woodland suitability group P)

Iosco Series

The Iosco series is made up of somewhat poorly drained, level soils on lake plains and outwash plains. These soils formed in sandy material underlain at a depth of 18 to 42 inches with loam, clay loam, or silty clay loam.

In a typical profile, the surface layer is very dark grayish-brown loamy sand about 9 inches thick. The upper part of the subsoil consists of a 5-inch layer of dark-brown, very friable loamy sand over a 9-inch layer of brown, very friable sand. Pale-brown, loose sand, 7 inches thick, separates this from the lower part of the subsoil, which consists of 4 inches of gray, firm silty clay loam mottled with yellowish brown. The underlying material, at a depth of 34 inches, is gray, firm, limy silty clay loam mottled with yellowish brown.

Fertility is low, and the available water capacity is moderately low. Runoff is very slow to slow. Permeability is rapid in the sandy upper layers and moderately slow in the finer textured lower layers. The water table is within 1 to 2 feet of the surface in spring and after prolonged rain in other seasons. When the water table recedes, the soils dry out quickly.

These soils are used as cropland, as pasture, and as woodland.

Typical profile of Iosco loamy sand:

Ap—0 to 9 inches, very dark grayish-brown (10YR 3/2) loamy sand; weak, fine, granular structure; very friable; medium acid; abrupt, smooth boundary.

B21ir—9 to 14 inches, dark-brown (7.5YR 4/4) loamy sand; weak, coarse, granular structure; very friable; slight cementation in places; medium acid; gradual, irregular boundary.

B22ir—14 to 23 inches, brown (7.5YR 5/4) sand; very weak, fine, granular structure; very friable; contains dark reddish-brown (5YR 3/4), weakly cemented nodules; medium acid; clear, wavy boundary.

A'2—23 to 30 inches, pale-brown (10YR 6/3) sand; many, medium, distinct, yellowish-brown (10YR 5/4) mottles; single grain; loose; medium acid; abrupt, smooth boundary.

IIB'tg—30 to 34 inches, gray (10YR 6/1) silty clay loam; many, medium, distinct, yellowish-brown (10YR 5/6) mottles; weak, coarse, subangular blocky structure; firm; mildly alkaline; abrupt, wavy boundary.

IICg—34 to 42 inches +, gray (10YR 6/1) silty clay loam; many, medium, distinct, yellowish-brown (10YR 5/6) mottles; massive; firm; calcareous.

In areas not yet farmed, there is a 2- to 4-inch, very dark grayish-brown or very dark brown A1 horizon and a 2- to 6-inch, light-gray or light brownish-gray A2 horizon. The texture of the IIB'tg horizon is clay loam or heavy loam in some areas. This layer is 3 to 10 inches thick. The texture of the IICg horizon ranges to loam or clay. The reaction of the sandy upper horizons is strongly acid to slightly acid, and that of the finer textured lower horizons is slightly acid to mildly alkaline.

Iosco soils are similar in texture to Menominee soils, which are better drained than Iosco soils and are not mottled. Iosco soils have coarser textured upper horizons than Belding soils and finer textured lower horizons than Au Gres soils.

Iosco loamy sand, 0 to 2 percent slopes (IoA).—This soil is on lake plains and outwash plains in the central and northern parts of the county. Included in mapping were small areas of gently sloping Iosco loamy sand next to drainageways.

Excessive wetness and low fertility are the main limitations for farming. The high water table delays and hinders planting and restricts the growth of roots. Drainage systems should be installed during periods of dry weather because ditches and trenches are likely to cave in when the soil material is wet. Some areas lack outlets for drainage, and some have topography unfavorable for drainage. Soil blowing is a hazard if large areas are tilled.

Corn, small grain, and forage crops are grown in areas that are artificially drained. (Capability unit IIIw–9 (4/2b); woodland suitability group G)

Kibbie Series

The Kibbie series is made up of somewhat poorly drained, level to gently sloping soils on lake plains and outwash plains. These soils formed in stratified water-deposited material, dominantly silt, very fine sand, and fine sand.

In a typical profile, the surface layer is very dark grayish-brown loam about 7 inches thick. The subsurface layer, about 4 inches thick, is grayish-brown, friable loam mottled with yellowish brown. The subsoil is about 23 inches thick. The upper 8 inches is grayish-brown, firm heavy silt loam mottled with dark brown, and the lower 15 inches is brown, firm, light silty clay loam mottled with yellowish brown and light brownish gray. The underlying material, at a depth of about 34 inches, is brown, friable, limy, stratified silt, fine sand, and very fine sand mottled with yellowish brown.

Fertility is moderate to moderately high, and the available water capacity is moderate to moderately high. Runoff is slow to ponded. Permeability is moderately slow. Mottling in the profile results from prolonged saturation.

Many areas are drained and used for corn, small grain, and other crops. Undrained areas are in pasture or in woodland.

Typical profile of a Kibbie loam:

Ap—0 to 7 inches, very dark grayish-brown (10YR 3/2) loam; moderate, fine, granular structure; friable; slightly acid; abrupt, wavy boundary.

A2g—7 to 11 inches, grayish-brown (10YR 5/2) loam; many, medium, distinct, yellowish-brown (10YR 5/4) mottles; moderate, medium, granular structure; friable; slightly acid; clear, smooth boundary.

B21tg—11 to 19 inches, grayish-brown (10YR 5/2) heavy silt loam; common, medium, distinct, dark-brown (10YR 4/3) mottles; moderate, medium, subangular blocky structure; firm; slightly acid; gradual, wavy boundary.

B22t—19 to 34 inches, brown (10YR 5/3) light silty clay loam; many, medium, distinct, yellowish-brown (10YR 5/6) and common, medium, faint, light brownish-gray (10YR 6/2) mottles; moderate, medium, subangular blocky structure; firm; neutral; abrupt, smooth boundary.

IIC—34 to 42 inches +, brown (10YR 5/3) stratified silt, fine sand, and very fine sand; common, medium, distinct, yellowish-brown (10YR 5/8) mottles; massive; friable; calcareous.

In undisturbed areas there is a very dark gray A1 horizon 2 to 4 inches thick. The texture of the B horizon ranges to loam, heavy fine sandy loam, or clay loam. The thickness of the A and B horizons combined ranges from 30 to about 40 inches. In a few areas the underlying material contains thin layers of loam, sandy loam, and medium sand. The reaction of the A and B horizons ranges from slightly acid to mildly alkaline.

Kibbie soils formed in material similar to that in which Colwood soils formed, but they are better drained and less gray than Colwood soils. Kibbie soils have coarser textured underlying material than Del Rey soils.

Kibbie loam, 0 to 2 percent slopes (KbA).—This soil is on lake plains and outwash plains throughout the county. In some areas the plow layer is dark gray rather than very dark grayish brown, and in some it is silt loam or fine sandy loam rather than loam. Included in mapping were small areas of gently sloping Kibbie soils. Also included were areas of Colwood soils in depressions and narrow drainageways. These included Colwood soils stay wet longer than the surrounding Kibbie soil.

Excessive wetness, particularly in early spring, is the main limitation for farming. It delays planting, interferes with the use of machinery, and hinders all farming operations. Drainage systems should be installed during dry periods because ditches and trenches are likely to cave in when the soil is wet. Special blinding material is needed to keep soil material from flowing into and filling tile drains. Maintaining good tilth is difficult in some areas. Cultivated areas next to more strongly sloping soils are slightly eroded.

Corn and small grain are important crops. (Capability unit IIw–4 (2.5b); woodland suitability group G)

Kibbie loam, 2 to 6 percent slopes (KbB).—This soil is on lake plains and outwash plains throughout the county. It has uniform slopes of medium length and predominantly of less than 4 percent gradient. Included in mapping were small areas of level Kibbie soils in narrow swales. Also included were areas of the more poorly drained Colwood soils in depressions and areas of Tuscola soils at slightly higher elevations.

Excessive wetness is the main limitation for farming. Drainage systems should be installed during dry periods because ditches and trenches are likely to cave in when the soil is wet. Special blinding material is needed to keep soil material from flowing into and filling tile drains. Random tile can be used to drain areas where undulating relief makes it difficult to put in a complete drainage system. Surface drains are needed to remove water from depressions and drainageways. The included Tuscola soils do not need artificial drainage.

Most of this soil is farmed intensively. Corn and small grain are important crops. (Capability unit IIw–5 (2.5b); woodland suitability group G)

Lapeer Series

The Lapeer series is made up of well-drained, level to very steep soils on till plains and moraines. These soils formed in glacial material of sandy loam texture.

In a typical profile, the surface layer is dark grayish-brown sandy loam about 8 inches thick. The subsurface layer, also about 8 inches thick, is pale-brown sandy loam. The subsoil is about 20 inches thick. It consists of 6 inches of brown, friable heavy sandy loam; 6 inches of brown, firm sandy clay loam; and 8 inches of yellowish-brown, firm heavy loam. The underlying material, at a depth of about 36 inches, is brown, friable, limy sandy loam.

Fertility is moderate, the available water capacity is moderate, and permeability is moderate. Runoff ranges from slow to very rapid, depending on the slope. These soils dry out quickly in spring and after rain in other seasons, and they are easy to work.

The level, gently sloping, and sloping soils of this series are used for crops, mainly corn, small grain, and hay. The steeper soils are in pasture or in woods.

Typical profile of a Lapeer sandy loam:

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) sandy loam; weak, coarse, granular structure; very friable; slightly acid; abrupt, wavy boundary.

A2—8 to 16 inches, pale-brown (10YR 6/3) sandy loam; moderate, medium, platy structure; friable; slightly acid; clear, wavy boundary.

B1t—16 to 22 inches, brown (10YR 5/3) heavy sandy loam; weak, medium, subangular blocky structure; friable; slightly acid; clear, irregular boundary.

B21t—22 to 28 inches, brown (10YR 4/3) sandy clay loam; moderate, medium, subangular blocky structure; firm; coatings of A2 sandy loam on ped faces and in root channels; slightly acid; gradual, wavy boundary.

B22t—28 to 36 inches, yellowish-brown (10YR 5/4) heavy loam; moderate, coarse, subangular blocky structure; firm; neutral; abrupt, wavy boundary.

C—36 to 48 inches +, brown (10YR 5/3) sandy loam; massive; friable; calcareous.

In undisturbed areas there is a very dark grayish-brown A1 horizon 1 to 3 inches thick. The thickness of the A and B horizons combined ranges from 22 to about 42 inches. The reaction of these two horizons ranges from medium acid to neutral.

Lapeer soils formed in material similar to that in which Dryden and Locke soils formed. Lapeer soils are better drained than either Dryden or Locke soils and lack the mottling that is characteristic of those soils. They have a coarser textured C horizon than Miami soils and a finer textured C horizon than Boyer or Oshtemo soils.

Lapeer sandy loam, 0 to 2 percent slopes (LaA).—This soil is on till plains. In areas intensively cultivated, the plow layer contains a little pale-brown sandy loam plowed up from the subsurface layer. Included in map-

ping were areas of Locke and Barry soils in narrow drainageways. These included soils stay wet longer than the adjacent Lapeer soils.

An occasional shortage of moisture is the main limitation for farming. There is little or no hazard of water erosion.

Most of this soil is farmed. Small grain, corn, and forage crops are important crops. (Capability unit IIs–2 (3a); woodland suitability group U)

Lapeer sandy loam, 2 to 6 percent slopes (LaB).—This soil occurs on till plains and moraines. The plow layer in cultivated areas contains a little pale-brown sandy loam plowed up from the subsurface layer. The slopes are generally uniform, are medium to long in length, and are mainly between 2 and 4 percent in gradient. Included in mapping were areas of level Lapeer soils. Also included were areas of Locke and Barry soils in narrow drainageways; these soils stay wet longer than the surrounding Lapeer soil.

A moderate hazard of erosion and a shortage of moisture in some years are the main limitations for farming.

Most areas of this soil are farmed. Small grain, corn, and forage crops are important crops. (Capability unit IIe–3 (3a); woodland suitability group U)

Lapeer sandy loam, 2 to 6 percent slopes, moderately eroded (LaB2).—This soil occurs as small areas on till plains and moraines. The plow layer is grayish-brown or brown, rather than dark grayish brown. Erosion has removed about half the original surface layer from much of the acreage and is still active. The present surface layer is less fertile than that of uneroded soils of this series, is lower in organic-matter content, and is more likely to crust. The slopes are short and irregular and are mainly between 4 and 6 percent in gradient.

The hazard of further erosion is the main limitation for farming.

All of this soil is farmed intensively. Corn, small grain, and forage crops are grown. (Capability unit IIe–3 (3a); woodland suitability group U)

Lapeer sandy loam, 6 to 12 percent slopes (LaC).—This soil is on moraines. The surface layer is dark grayish brown, and in some areas it has a loam texture. The slopes are mainly short and irregular. Included in mapping were areas of less sloping Lapeer soils on knolls and ridges.

A hazard of erosion and a shortage of moisture during dry periods are the main limitations for farming. Control of runoff is needed, both to limit erosion and to conserve moisture.

Most of this soil is in woods or pasture. Small areas are farmed. (Capability unit IIIe–6 (3a); woodland suitability group U)

Lapeer sandy loam, 6 to 12 percent slopes, moderately eroded (LaC2).—This soil is on moraines. It has short, irregular slopes. The plow layer is mainly grayish brown or brown in color, and in a few areas it has a loam texture. Erosion has removed about half the original surface layer and is still active. The present surface layer is less fertile than that of uneroded soils of this series, is lower in organic-matter content, and is more likely to crust. Included in mapping were a few severely eroded areas, in which the subsoil is exposed, and some areas in which shallow gullies have formed.

The hazard of further erosion is the main limitation for farming. Contour tillage and contour stripcropping for control of runoff and erosion are impractical in some areas because of the short, irregular slopes. These areas can be protected by using cropping systems that consist largely of wheat, grasses, legumes, or other close-growing crops. A shortage of moisture during dry periods is an additional limitation.

Most of this soil is farmed. Small grain, corn, forage crops, and pasture are the main crops. (Capability unit IIIe–6 (3a); woodland suitability group U)

Lapeer sandy loam, 6 to 12 percent slopes, severely eroded (LaC3).—This soil is on moraines. It commonly occurs as narrow borders around fields of gently sloping soils. It has short, irregular slopes. The plow layer is brown or yellowish brown. Erosion has removed about two-thirds of the original surface layer from most areas, and the present surface layer is less fertile, has poorer tilth, is lower in organic-matter content, and is more likely to crust than the surface layer of an uneroded soil of this series. Seeds do not germinate evenly, and stands of plants are poor. In many areas the surface is partly covered with cobblestones, gravel, and stones. Shallow gullies have formed in some areas.

This soil is severely limited by the effects of erosion and the hazard of further erosion. Contour farming and contour stripcropping for control of runoff and erosion are not practical, because of the short, irregular slopes, but cover crops and grassed waterways can be used.

Much of this soil is cultivated along with the adjoining less sloping soils. Some areas have been abandoned and are now in brush and native grass. (Capability unit IVe–6 (3a); woodland suitability group U)

Lapeer sandy loam, 12 to 18 percent slopes, moderately eroded (LaD2).—This soil is on moraines. It has short, irregular slopes. The plow layer is grayish brown or brown. Erosion has removed about half the original surface layer from much of the acreage and is still active. The present surface layer is less fertile, is lower in organic-matter content, is more likely to crust, and has less capacity to absorb water than that of an uneroded soil of this series. Included in mapping were a few small spots so severely eroded that the subsoil is exposed. Germination of seeds is uneven in these severely eroded areas, and stands of plants are poor. Other inclusions are a few areas in which shallow gullies have formed, areas of less sloping Lapeer soils on ridges and knolls, and areas of steeper Lapeer soils on abrupt breaks in the landscape.

The slope, rapid runoff, and the erosion hazard are the main limitations for farming. The available water supply is limited during dry periods because so much water is lost through runoff.

Most of this soil is cultivated. Some areas are in native hay or pasture. (Capability unit IVe–4 (3a); woodland suitability group U)

Lapeer sandy loam, 12 to 18 percent slopes, severely eroded (LaD3).—This soil occurs as small areas on moraines. It has short, irregular slopes that vary in gradient within short distances. The plow layer is brown. Erosion has removed about two-thirds of the original surface layer from most of the acreage. The present surface layer has poor tilth, tends to crust when dry, and is less fertile and

lower in organic-matter content than the original surface layer. In many small areas the brown layer in the subsoil is exposed and has eroded. Shallow gullies have formed in some areas.

The slope and the erosion hazard are severe limitations for farming. Runoff is rapid in cultivated areas.

All of this soil has been cultivated in the past, but most of it has been abandoned and is now covered with brush, small trees, and native grass. Permanent vegetation is desirable. (Capability unit VIe–2 (3a); woodland suitability group U)

Lapeer sandy loam, 18 to 25 percent slopes, moderately eroded (LaE2).—This soil occurs as small areas on moraines. Areas of it commonly consist of several small steep hills separated by low wet areas or drainageways. The slopes are short and irregular, and the gradient varies within short distances. The plow layer is brown sandy loam. Erosion has removed about half of the original surface layer, and the present surface layer is less fertile, contains less organic matter, crusts more readily, and has less capacity to absorb water than the original surface layer. In a few areas brown sandy clay loam is exposed, and a few gullies have formed. Included in mapping were less sloping areas on ridges, on knolls, and at the base of slopes.

The slope and the erosion hazard are severe limitations for farming.

This soil has been cultivated. It should now be planted to trees or to some other kind of permanent vegetation that would help to check erosion. (Capability unit VIe–2 (3a); woodland suitability group U)

Lapeer sandy loam, 18 to 25 percent slopes, severely eroded (LaE3).—This soil is on moraines. The slopes are short and irregular, and the gradient varies considerably within short distances. The plow layer is brown. Erosion has removed about two-thirds of the original surface layer from most of the acreage. The present surface layer has poor tilth, crusts readily, and is less fertile and lower in organic-matter content than the original surface layer. In many small areas the brown layer in the subsoil is exposed, and in a few areas shallow gullies have formed.

The slope and the erosion hazard are severe limitations for farming. Operating farm machinery is hazardous.

Most of the acreage now has a cover of native grass, brush, and small trees. Some areas are used for pasture. Trees or other permanent vegetation that would help to control erosion should be encouraged. (Capability unit VIIe–2 (3a); woodland suitability group U)

Lapeer sandy loam, 25 to 60 percent slopes (LaF).—This soil is on moraines. Areas of it commonly consist of several small steep hills separated by low, wet areas or drainageways. The slopes are short and irregular, and the gradient varies within short distances. The surface layer is brown. Included in mapping were less sloping soils on knolls, on ridges, and at the base of slopes, and also a few areas of moderately eroded soils.

The slope and the erosion hazard make this soil unsuitable for cultivation. Operating farm machinery is hazardous.

Most of the acreage is in woods or native pasture. Wooded areas should not be cleared. In areas already cleared, the establishment of trees or other permanent vegetation should be encouraged. (Capability unit VIIe–2 (3a); woodland suitability group U)

Lenawee Series

The Lenawee series is made up of poorly drained, level to depressional soils on lake plains. These soils formed in stratified silty clay loam and clay loam.

In a typical profile, the surface layer is very dark brown silty clay loam about 8 inches thick. The subsoil, about 26 inches thick, consists of dark grayish-brown, firm to very firm silty clay loam and heavy silty clay loam mottled with olive brown and light olive brown. The underlying material, at a depth of 34 inches, is grayish-brown, firm, limy, stratified silty clay loam, clay loam, silt, and fine sand mottled with olive brown.

Fertility is high, and the available water capacity is high. Permeability is moderately slow. Runoff is very slow to ponded. The grayish color of the subsoil is a result of prolonged saturation.

Most areas have been drained and are used for crops or pasture. Undrained areas have a cover of swamp vegetation or brush.

Typical profile of Lenawee silty clay loam:

Ap—0 to 8 inches, very dark brown (10YR 2/2) silty clay loam; moderate, medium, granular structure; firm; considerable organic material; slightly acid; abrupt, smooth boundary.

B21g—8 to 14 inches, dark grayish-brown (2.5Y 4/2) silty clay loam; few, medium, faint, olive-brown (2.5Y 4/4) mottles; moderate, medium, angular blocky structure; firm when moist, plastic when wet; slightly acid; clear, wavy boundary.

B22g—14 to 34 inches, dark grayish-brown (2.5Y 4/2) heavy silty clay loam; common, medium, faint, olive-brown (2.5Y 4/4) and light olive-brown (2.5Y 5/4) mottles; moderate, coarse, angular blocky structure; very firm; mildly alkaline; abrupt, smooth boundary.

Cg—34 to 42 inches +, grayish-brown (2.5Y 5/2) stratified silty clay loam, clay loam, silt, and fine sand; common, medium, distinct, olive-brown (2.5Y 4/4) mottles; weak, medium, angular blocky structure; firm; calcareous.

The color of the A horizon is black in some areas. The thickness of this horizon ranges from 7 to 10 inches. Layers of fine sand and silt, 1 to 4 inches thick, occur in the B and C horizons in many areas. The thickness of the A and B horizons combined ranges from 25 to 42 inches. The reaction of these two horizons ranges from slightly acid to mildly alkaline.

Lenawee soils formed in material similar to that in which Del Rey soils formed, but they are more poorly drained and grayer than Del Rey soils. They have a finer textured underlying material than Colwood soils and coarser textured underlying material than Hoytville soils. The underlying material of Lenawee soils is more varied in texture and more stratified than that of Pewamo soils.

Lenawee silty clay loam (0 to 1 percent slopes) (Le).—This soil is on lake plains in the central and southern parts of the county. The plow layer is very dark brown to black and in some areas contains a little dark grayish-brown and olive-brown silty clay loam plowed up from the subsoil.

Excessive wetness and poor tilth are the main limitations for farming. The soil dries out slowly in spring and after rain in other seasons. If tilled when wet it puddles and compacts and then dries out hard and cloddy. Farm machinery bogs down readily. Tile and open ditches are needed to improve drainage, and diversions are needed to intercept runoff from adjoining higher soils. Frost damage to crops is a hazard.

If drained, this soil is suitable for farming. Corn is the crop commonly grown. (Capability unit IIw–2 (1.5c); woodland suitability group P)

Linwood Series

The Linwood series is made up of very poorly drained, level to depressional soils on till plains, outwash plains, and moraines. These soils formed in organic material derived from woody and fibrous plants. The organic material was 12 to 42 inches thick over loamy material.

In a typical profile, the surface layer is black muck about 18 inches thick. Below the surface layer and extending to a depth of about 36 inches is black or very dark grayish-brown, very friable muck that contains numerous woody fragments. The underlying material is gray, firm, mildly alkaline silt loam.

Fertility is low. The available water capacity is high, and so the supply of moisture usually is adequate for plants. Permeability is rapid in the upper layers and moderate to moderately slow in the lower layers. Runoff is slow to very slow, and water ponds in some of the lowest spots. The water table is at or near the surface unless lowered by artificial drainage. The organic material settles if the water table is lowered too much.

Drained areas of these soils are used for truck crops. Undrained areas remain in woods or are used for pasture.

Typical profile of Linwood muck:

1—0 to 18 inches, black (10YR 2/1) muck; moderate, medium, granular structure; very friable; slightly acid; gradual, wavy boundary.

2—18 to 32 inches, black (5Y 2/2) muck that contains numerous woody fragments; weak, fine, granular structure; very friable; slightly acid; clear, wavy boundary.

3—32 to 36 inches, very dark grayish-brown (10YR 3/2) muck; thin strata and lenses of silt; weak, fine, granular structure; very friable; neutral; abrupt, smooth boundary.

IICg—36 to 42 inches +, gray (N 6/0) silt loam; massive; firm; mildly alkaline; gradual, smooth boundary.

The amount of woody material varies but is generally significant. In some areas peaty muck occurs at a depth of 24 inches. The texture of the underlying material ranges from loam to light silty clay loam. The reaction of the organic material ranges from medium acid to neutral.

Linwood soils have a thinner layer of organic material than either Carlisle or Houghton soils. They differ from Willette and Tawas soils in the texture of the underlying material; Willette soils are underlain with clay and Tawas soils with sand.

Linwood muck (0 to 1 percent slopes) (lm).—This soil occurs in low swampy areas throughout the county.

Excessive wetness is the main limitation for farming. When the soil is wet, farm machinery bogs down and all farming operations are hindered. Drainage is needed, but it has to be controlled because lowering the water table too much causes the organic material to settle. Low fertility is also a limitation; the soil is deficient in phosphorus, potassium, and micronutrients. Soil blowing and fire are hazards if crops are grown. Frost damage is a hazard to crops, especially in the lowest spots.

If adequately drained and fertilized and protected from blowing, this soil is well suited to many short-season, frost-resistant crops. Most large areas are drained and are cultivated intensively. Small areas are in woods. (Capability unit IIw–10 (M/3c); woodland suitability group J)

412–409—71——4

Locke Series

The Locke series is made up of somewhat poorly drained, level to gently sloping soils on till plains and low moraines. These soils formed in glacial material of sandy loam texture.

In a typical profile, the surface layer is very dark grayish-brown sandy loam about 8 inches thick. The subsurface layer, about 5 inches thick, is pale-brown sandy loam mottled with dark yellowish brown and yellowish brown. The subsoil is about 17 inches thick. The upper 4 inches is brown, friable heavy sandy loam mottled with dark brown and light brownish gray. The lower 13 inches is grayish-brown, firm sandy clay loam mottled with dark yellowish brown. The underlying material, at a depth of about 30 inches, is light brownish-gray, friable, limy sandy loam mottled with yellowish brown.

Fertility is moderate, and the available water capacity is moderate. The water table is usually within a foot or two of the surface in spring and during wet periods in other seasons. Permeability is moderate, except when the water table is high. When drained, these soils dry out quickly and are easy to till.

Most areas of these soils are now used for crops, mainly corn, small grain, and forage crops.

Typical profile of a Locke sandy loam:

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) sandy loam; weak, fine, granular structure; friable; moderately high organic-matter content; slightly acid; abrupt, smooth boundary.

A2—8 to 13 inches, pale-brown (10YR 6/3) sandy loam; common, medium, distinct, dark yellowish-brown (10YR 4/4) and yellowish-brown (10YR 5/6) mottles; weak, medium, granular structure; very friable; medium acid; clear, wavy boundary.

B21t—13 to 17 inches, brown (10YR 5/3) heavy sandy loam; common, medium, distinct, dark-brown (10YR 4/3) and light brownish-gray (10YR 6/2) mottles; weak, fine, subangular blocky structure; friable; slightly acid; gradual, wavy boundary.

B22tg—17 to 30 inches, grayish-brown (10YR 5/2) sandy clay loam; many, medium, distinct, dark yellowish-brown (10YR 4/4) mottles; moderate, medium, subangular blocky structure; firm; slightly acid; abrupt, irregular boundary.

Cg—30 to 42 inches +, light brownish-gray (10YR 6/2) sandy loam; few, medium, distinct, yellowish-brown (10YR 5/6) mottles; massive; friable; calcareous.

In areas not yet farmed, there is a very dark gray A1 horizon 2 to 4 inches thick. The depth to mottling ranges from 8 to about 16 inches. The texture of the B horizon ranges to heavy loam or light clay loam. The thickness of the A and B horizons combined ranges from 20 to about 42 inches but is most commonly between 24 and 40 inches. In some areas the underlying material contains thin layers and pockets of loamy sand and sand. The reaction of the A and B horizons ranges from medium acid to slightly acid.

Locke soils formed in material similar to that in which the better drained, less mottled Dryden soils and the better drained, unmottled Lapeer soils formed. Locke soils are better drained and less gray than Barry soils. They have a coarser textured C horizon than Conover soils.

Locke sandy loam, 0 to 2 percent slopes (LoA).—This soil occurs on till plains and low moraines throughout the county. In some areas the plow layer contains a little pale-brown sandy loam plowed up from the subsurface layer, and in some areas the plow layer is loam rather than sandy loam. Included in mapping were areas of Barry soils in narrow drainageways.

This Locke soil is affected by runoff from adjacent higher soils and by a high water table that restricts the growth of roots and hinders the operation of farm machinery. Tile drains and open ditches are needed to remove excess water. Shallow surface drains can be used to remove standing water from low areas.

Corn, small grain, and forage crops are important crops. (Capability unit IIw–6 (3b); woodland suitability group G)

Locke sandy loam, 2 to 6 percent slopes (LoB).—This soil occurs on till plains and low moraines throughout the county. The plow layer is very dark grayish brown. In some areas it contains a little material plowed up from the subsurface layer, and in some areas it is loam rather than sandy loam. The slopes are uniform and of medium length, and the topography is undulating. Included in mapping were areas of moderately eroded soils that have a slope range of 4 to 6 percent, small areas of level Locke soils, and areas of Barry soils in narrow drainageways. The included Barry soils stay wet longer than the surrounding Locke soil.

This Locke soil is affected by a high water table and by runoff from adjacent higher soils. Laying out a complete drainage system is difficult, because of the undulating relief and closed depressions, but random tile drains and surface drains are effective.

Corn and small grain are important crops. (Capability unit IIw–7 (3b); woodland suitability group G)

Lupton Series

The Lupton series is made up of very poorly drained, level to depressional, organic soils on lake plains, till plains, outwash plains, and moraines. These soils formed in woody and fibrous material more than 42 inches thick.

In a typical profile, the surface layer is black muck about 24 inches thick. It contains woody fragments and undecomposed muck. Below the surface layer and extending to a depth of about 36 inches is very dark grayish-brown, soft muck that contains fibrous and woody material. Below this is dark-brown peaty muck that contains fibrous material. This layer extends to a depth of 48 inches or more.

Fertility is low, the available water capacity is high, and permeability is rapid. Runoff is very slow, and water ponds in depressions in wet years. The water table is at or near the surface unless lowered by artificial drainage. If the water table is lowered too much, the organic material settles.

Areas that are drained and protected against blowing are used for truck crops. Undrained areas are in woods or pasture.

Typical profile of Lupton muck:

1—0 to 24 inches, black (10YR 2/1) muck; moderate, medium, granular structure; friable; many wood fragments and roots; mildly alkaline; gradual, wavy boundary.
2—24 to 36 inches, very dark grayish-brown (10YR 3/2) muck; massive; soft; mixed fibrous and woody materials; mildly alkaline; gradual, wavy boundary.
3—36 to 48 inches +, dark-brown (10YR 3/3) peaty muck; massive; soft; mostly fibrous materials; moderately alkaline.

The color of the surface layer is very dark brown in some areas. The material below a depth of 24 to 40 inches is muck or peaty muck, and that below a depth of 40 inches is peaty muck or peat. In many areas the organic material extends to a depth of 10 feet or more. The reaction is mildly alkaline in the upper 3 feet and moderately alkaline below a depth of 3 feet.

Lupton soils are more alkaline than either Carlisle or Houghton soils. They have a thicker layer of organic material than Linwood, Tawas, or Willette soils.

Lupton muck (0 to 1 percent slopes) (Lu).—This soil is in low swampy areas throughout the county.

This soil is low in phosphorus and potassium and in micronutrients, including manganese, boron, copper, and zinc. It contains so much lime that some micronutrients are not available to plants and some crops—blueberries and onions, for example—cannot be grown successfully. When the soil is wet, farm machinery bogs down and farming operations are delayed. The high water table restricts the growth of roots. Control of drainage is important, because the organic material settles if the water table is lowered too much. Frost damage is a hazard to crops in the lowest spots. Soil blowing and fire are additional hazards.

If artificially drained, adequately fertilized, and protected against blowing, this soil is suited to many short-season, frost-resistant crops. The larger areas have been drained and are cultivated intensively. Small areas are in woods. (Capability unit IIIw–15 (Mc); woodland suitability group J)

Macomb Series

The Macomb series is made up of somewhat poorly drained, level to undulating soils on till plains. These soils formed in sandy loam and loam material underlain at a depth of 18 to 42 inches with loam and clay loam.

In a typical profile, the surface layer is very dark grayish-brown sandy loam about 8 inches thick. The subsurface layer, about 3 inches thick, is brown sandy loam mottled with yellowish brown. The subsoil is about 19 inches thick. The upper 3 inches is yellowish-brown, firm heavy loam mottled with grayish brown. The lower 16 inches is brown, friable, limy gravelly clay loam mottled with dark yellowish brown and light brownish gray. The underlying material is light brownish-gray, friable, limy loam.

Fertility is moderate or moderately high, and the available water capacity is moderate. Permeability is moderate. Runoff is slow, and water ponds in small depressions in wet years. The water table is high in spring and during wet weather in other seasons.

These soils are used for crops, mainly corn, small grain, and forage crops.

Typical profile of a Macomb sandy loam:

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) sandy loam; moderate, fine, granular structure; friable; moderately high organic-matter content; slightly acid; abrupt, smooth boundary.
A2—8 to 11 inches, brown (10YR 5/3) sandy loam; few, fine, distinct, yellowish-brown (10YR 5/8) mottles; weak, fine, subangular blocky structure; friable; medium acid; clear, wavy boundary.
B21t—11 to 14 inches, yellowish-brown (10YR 5/4) heavy loam; common, medium, distinct, grayish-brown (10YR 5/2) mottles; moderate, medium, subangular blocky structure; firm; medium acid; clear, wavy boundary.
B22t—14 to 30 inches, brown (10YR 5/3) gravelly clay loam; common, medium, distinct, dark yellowish-brown (10YR 4/4) and light brownish-gray (10YR 6/2)

mottles; strong, medium, subangular blocky structure; firm; slightly acid; abrupt, wavy boundary.
IICg—30 to 42 inches +, light brownish-gray (10YR 6/2) loam; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; weak, medium, subangular blocky structure; friable; calcareous.

In undisturbed areas there is a very dark gray A1 horizon 2 to 4 inches thick. The texture of the upper part of the B horizon is gravelly loam or heavy sandy loam in many areas, and that of the lower part is gravelly sandy clay loam in a few areas. The thickness of the A and B horizons combined ranges from 24 to about 42 inches. In a few areas the texture of the C horizon is light clay loam. The reaction of the A and B horizons ranges from medium acid to slightly acid.

Macomb soils are better drained than Berville soils. They lack the sand and gravel C horizon that is characteristic of Matherton soils.

Macomb sandy loam, 0 to 2 percent slopes (MaA).—This soil is on till plains in the southern part of the county. In a few areas the plow layer is loam, and in a few it is gravelly sandy loam. Included in mapping were areas of Sebewa soils in narrow drainageways. These included soils dry out more slowly than Macomb soils.

Wetness early in spring is the main limitation for farming. Stones and cobblestones on the surface hinder cultivation in a few areas.

If drained, this soil is suited to corn, small grain, and forage crops. Most of it is cultivated. Small areas remain in woods. (Capability unit IIw–8 (3/2b); woodland suitability group G)

Macomb sandy loam, 2 to 6 percent slopes (MaB).—This soil is on till plains in the southern part of the county. It has uniform, short to medium-length slopes. The plow layer contains some gravel. In a few areas it is loam rather than sandy loam, and in a few areas it contains a little brown sandy loam plowed up from the subsurface layer. Included in mapping were areas of level Macomb soils.

Excessive wetness early in spring is the main limitation for farming. Undulating relief and closed depressions make it hard to lay out a complete drainage system, but random tile is effective. Stones and cobblestones on the surface hinder cultivation in a few areas.

If drained, this soil is suited to corn, small grain, and forage crops. Most of it is cultivated. Small areas remain in woods. (Capability unit IIw–8 (3/2b); woodland suitability group G)

Made Land

Made land (Md) consists of material hauled in and used for fill. It has a slope range of 0 to 2 percent. The composition of the material varies, and the size of the areas varies greatly. Some areas were formerly rubbish dumps. (Capability unit VIIIs–1 (Sa); no woodland suitability classification)

Mancelona Series

The Mancelona series is made up of well drained to moderately well drained, level to undulating soils on outwash plains, lake plains, and low moraines. These soils formed in deposits of loamy sand and sand. The Mancelona soils mapped in Lapeer County are underlain with loamy to clayey material at a depth of 42 to 66 inches. Mancelona soils in other localities are underlain with sand and gravel.

In a typical profile, the surface layer is dark-brown loamy sand about 8 inches thick. Below the plow layer is a 4-inch layer of strong-brown, very friable gravelly loamy sand; an 8-inch layer of brown, very friable loamy sand; and then an 8-inch layer of dark-brown, very friable heavy gravelly loamy sand. The substratum, at a depth of about 48 inches, is yellowish-brown, firm, limy silty clay loam.

Fertility is low, and the available water capacity is moderately low. Runoff is slow to medium, depending on the slope. Permeability is rapid in the upper layers and moderately slow in the underlying material. These soils warm up and are ready for tillage early in spring.

Most areas of these soils are farmed.

Typical profile of a Mancelona loamy sand, moderately fine substratum:

Ap—0 to 8 inches, dark-brown (10YR 4/3) loamy sand; very weak, fine, granular structure; very friable; medium acid; abrupt, smooth boundary.
Bir—8 to 12 inches, strong-brown (7.5YR 5/6) gravelly loamy sand; very weak, fine, granular structure; very friable; medium acid; clear, wavy boundary.
A'2—12 to 20 inches, brown (10YR 5/3) loamy sand; very weak, coarse, granular structure; very friable; medium acid; clear, wavy boundary.
B't—20 to 48 inches, dark-brown (10YR 4/3) heavy gravelly loamy sand; weak, medium, subangular blocky structure; very friable; slightly acid; abrupt, wavy boundary.
IIC—48 to 60 inches +, yellowish-brown (10YR 5/4) silty clay loam; weak, coarse, angular blocky structure; firm; calcareous.

In areas not yet cultivated, there is a very dark grayish-brown A1 horizon 1 to 3 inches thick and a gray or light brownish-gray A2 horizon 2 to 4 inches thick. The texture of the B horizon in some areas is light sandy loam or light gravelly sandy loam. In a few places a 1- to 4-inch layer of gravel and sand lies between the B't horizon and the finer textured IIC horizon. The depth to the IIC horizon ranges from 42 to about 66 inches, and the texture of this horizon ranges from loam to clay. The reaction of the A and B horizons ranges from medium acid to neutral.

Mancelona soils, moderately fine substratum, are deeper to the substratum than Menominee soils. They have a Bir horizon, which Montcalm soils lack.

Mancelona loamy sand, moderately fine substratum, 0 to 6 percent slopes (MeB).—This soil occurs on outwash plains and lake plains throughout the county. The plow layer is dark brown. Included in mapping were small areas of gently sloping Mancelona soils.

The available water capacity is moderately low, and crops are affected by a lack of moisture in most years. Soil blowing is a slight hazard in unprotected areas.

Most of this soil is used for crops, mainly corn, small grain, and forage crops. (Capability unit IIIs–4 (4a); woodland suitability group C)

Mancelona loamy sand, moderately fine substratum, 6 to 12 percent slopes, moderately eroded (MeC2).—This soil occurs on moraines throughout the county. The slopes are short and irregular. Erosion has removed about half of the original surface layer. The present plow layer is brown. In some areas it contains a little strong-brown gravelly loamy sand plowed up from the subsoil. It is less fertile and lower in organic-matter content than the surface layer of the uneroded soils of this series.

Further erosion is a hazard, and a shortage of available water affects crops in most years.

All of this soil is now farmed or has been in the past. Small grain, forage crops, and pasture are the main crops. (Capability unit IIIe–9 (4a); woodland suitability group C)

Marlette Series

The Marlette series is made up of well drained to moderately well drained, level to very steep soils on till plains and moraines. These soils formed in material of loam texture.

In a typical profile (fig. 11), the surface layer is very dark grayish-brown sandy loam about 8 inches thick. The subsurface layer, about 10 inches thick, is pale-brown, friable sandy loam. The subsoil is dark yellowish-brown, firm clay loam about 13 inches thick. At a depth of about 31 inches is brown, friable, limy sand.

Fertility is high, and the available water capacity is high. Permeability is moderately slow. Runoff ranges from slow to rapid, depending on the slope. These soils dry out and are ready for tillage early in spring.

The level to sloping areas of these soils are intensively farmed. Corn, small grain, and forage crops are the main crops. The steeper areas are used for forage crops, pasture, and trees.

Typical profile of a Marlette sandy loam:

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) sandy loam; moderate, medium, granular structure; very friable; slightly acid; abrupt, wavy boundary.

A2—8 to 18 inches, pale-brown (10YR 6/3) sandy loam; moderate, coarse, granular structure; friable; medium acid; abrupt, irregular boundary.

B2t—18 to 31 inches, dark yellowish-brown (10YR 4/4) clay loam; pale-brown (10YR 6/3) A2 material occurs as very thick ped coatings and crack fillings in the uppermost 3 to 5 inches; moderate, medium, subangular blocky structure; firm; slightly acid; abrupt, wavy boundary.

C—31 to 48 inches +, brown (10YR 5/3) loam; massive; friable; calcareous.

In areas not yet farmed, there is a very dark grayish-brown A1 horizon 2 to 4 inches thick. In some places the color of the B horizon is dark brown, and in some the texture of this horizon is silty clay loam. The thickness of the A and B horizons combined ranges from 24 to 42 inches. The texture of the C horizon in a few areas is silt loam. The reaction of the A and B horizons ranges from medium acid to slightly acid.

Marlette soils are better drained than Capac soils, and they lack the mottling in the B horizon that is characteristic of Capac soils. They have finer textured underlying material than McBride soils.

Marlette sandy loam, 0 to 2 percent slopes (MfA).—This soil occurs on till plains in the northern part of the county. In a few areas the plow layer is loam rather than sandy loam. Included in the larger areas mapped were small bodies of darker colored Capac soils and some poorly drained soils in depressions. The included Capac soils and the soils in depressions stay wet longer than the surrounding Marlette soil.

This Marlette soil has no serious limitations for farming. Most of the rainwater is absorbed, and little runs off. The erosion hazard is not significant.

Most of the acreage is farmed. Small grain, corn, and forage crops are the common crops. (Capability unit I–1 (2.5a); woodland suitability group D)

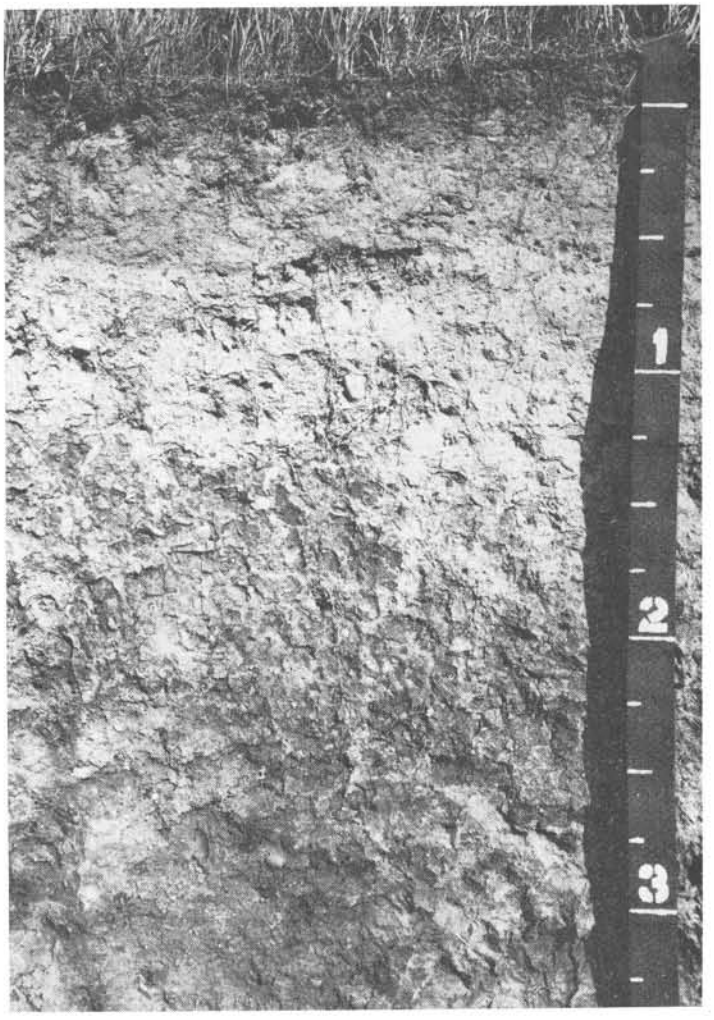

Figure 11.—**Profile of a Marlette sandy loam. Numbers on tape indicate depth in feet.**

Marlette sandy loam, 2 to 6 percent slopes (MfB).—This soil occurs on moraines and on undulating till plains in the central and northern parts of the county. On the uplands, the slopes are uniform and are short to medium in length; on the undulating plains, the slopes are medium to long. The plow layer is mainly very dark grayish brown in color, and in a few areas it has a loam texture. Included in mapping were small areas of moderately eroded Marlette soils and of level Marlette soils. The larger areas also include poorly drained soils in depressions and Capac soils in drainageways; these inclusions stay wet longer than the surrounding Marlette soils.

A moderate hazard of erosion is the main limitation for farming.

Most of this soil is intensively farmed. Corn, small grain, and forage crops are the common crops. (Capability unit IIe–2 (2.5a); woodland suitability group D)

Marlette sandy loam, 2 to 6 percent slopes, moderately eroded (MfB2).—This soil is on moraines and undulating till plains in the central and northern parts of the county. The slopes are uniform and are short to medium in length. The plow layer is brown. In some places

it is loam rather than sandy loam in texture, and in some it contains a little dark yellowish-brown clay loam plowed up from the subsoil. Fertility is lower, the organic-matter content is less, runoff is more rapid, tilth is poorer, and crusting of the surface is more likely than in uneroded Marlette soils. Included in mapping were small areas of severely eroded Marlette soils that have short slopes of 5 or 6 percent. Gravel and cobblestones are scattered on the surface in these severely eroded spots; germination of seeds is uneven, and stands of plants are poor. Also included were spots of darker colored Capac soils in drainageways. These included Capac soils stay wet longer than the surrounding Marlette soil.

A moderate hazard of further erosion is the main limitation for farming.

Most of this soil is intensively farmed. Corn, small grain, and forage crops are the common crops. (Capability unit IIe–2 (2.5a); woodland suitability group D)

Marlette sandy loam, 6 to 12 percent slopes (MfC).—This soil is on moraines in the central and northern parts of the county. The slopes are short and irregular. The surface layer is very dark grayish brown, and in a few areas it is loam rather than sandy loam in texture. Included in mapping were small areas of level and gently sloping Marlette soils.

A severe erosion hazard is the main limitation for farming. Contour tillage and contour stripcropping are not practical, because of the short, irregular slopes. Grasses and legumes in the cropping sequence help to check runoff and control erosion.

Most of this soil is in woods or is used for forage crops or pasture. Corn and small grain are the main cultivated crops. (Capability unit IIIe–5 (2.5a); woodland suitability group D)

Marlette sandy loam, 6 to 12 percent slopes, moderately eroded (MfC2).—This soil is on moraines in the central and northern parts of the county. The slopes are short and slightly irregular. In most areas the plow layer consists of brown heavy sandy loam. In some areas it is loam rather than sandy loam, and in some it contains dark yellowish-brown clay loam plowed up from the subsoil. The present plow layer is less fertile, contains less organic matter, has poorer tilth, is more likely to crust, and contains more gravel than that of uneroded Marlette soils. Included in mapping were severely eroded spots, in which the dark yellowish-brown subsoil is exposed and gravel and cobblestones are scattered on the surface. In these severely eroded spots, germination of seeds is uneven and stands of plants are poor. Small areas of level and gently sloping Marlette soils were included also.

The hazard of further erosion is the main limitation for farming. Contour farming and contour stripcropping are not practical, because of short, irregular slopes. Grasses and legumes in the cropping sequence help to check runoff and control erosion.

All of this soil is or has been intensively farmed. Corn, small grain, and forage crops are the main crops. (Capability unit IIIe–5 (2.5a); woodland suitability group D)

Marlette sandy loam, 6 to 12 percent slopes, severely eroded (MfC3).—This soil is on moraines in the central and northern parts of the county. The slopes are short and irregular. Most of the original surface layer and subsurface layer has been removed by erosion, and the clay loam subsoil is exposed in small areas. The present plow layer is dark yellowish brown. It is less fertile, contains less organic matter, absorbs less water and allows more to runoff, and is more likely to crust than the plow layer of uneroded Marlette soils. Germination of seeds is uneven, and stands of plants are poor. Shallow gullies have formed in a few areas, mainly in natural drainageways.

The hazard of further erosion is a very severe limitation for farming.

All of this soil has been farmed intensively, but now much of it is idle or is in brush or native grass. Close-growing crops are better suited than row crops. Permanent vegetation reduces the risk of further erosion. (Capability unit IVe–5 (2.5a); woodland suitability group D)

Marlette sandy loam, 12 to 18 percent slopes, moderately eroded (MfD2).—This soil is on moraines in the central and northern parts of the county. The slopes are short and irregular. Erosion has removed part of the original surface layer. The present plow layer of brown heavy sandy loam contains some dark yellowish-brown clay loam plowed up from the subsoil. It is less fertile, contains less organic matter, is more likely to crust, has poorer tilth, and contains more gravel than the plow layer of uneroded Marlette soils. Included in mapping were small areas of severely eroded Marlette soils, in which the subsoil is exposed and gravel and cobblestones are scattered on the surface. In these severely eroded spots, germination of seeds is uneven and stands of plants are poor. Other inclusions are small areas of less sloping Marlette soils on ridges, spurs, and knolls and small areas of steeper Marlette soils next to drainageways and depressions.

The slope and the erosion hazard are severe limitations for farming. Contour farming and contour stripcropping are impractical, because of the short, irregular slopes. Grasses and legumes in the cropping sequence help to check runoff and control erosion.

All of this soil has been intensively farmed. Most of it is now in forage crops or pasture. Some is used for native pasture, some is idle, and some has been reforested. Only small areas are used for corn and small grain. (Capability unit IVe–4 (2.5a); woodland suitability group D)

Marlette sandy loam, 12 to 18 percent slopes, severely eroded (MfD3).—This soil is on moraines in the central and northern parts of the county. The slopes are short and irregular. Most of the original surface layer and subsurface layer has been removed by erosion. The present plow layer is dark yellowish brown. It is less fertile, contains less organic matter, absorbs less water and allows more runoff, and is more likely to crust than the plow layer of uneroded Marlette soils. Germination of seeds is uneven, and stands of plants are poor. Numerous gullies have formed in some areas.

The effects of erosion and the hazard of further erosion make this soil unsuitable for cultivation.

All of the acreage was farmed intensively in the past, but now much of it has been abandoned. Pasture and forage crops are suitable uses. Some areas ought to be reforested. (Capability unit VIe–2 (2.5a); woodland suitability group D)

Marlette sandy loam, 18 to 25 percent slopes, moderately eroded (MfE2).—This soil is on moraines in the central and northern parts of the county. It has short, irregular slopes that vary in gradient considerably within short distances. The brown plow layer contains some dark yellowish-brown clay loam plowed up from the subsoil. It is less fertile, contains less organic matter, has poorer tilth, is more likely to crust, and contains more gravel than the surface layer of uneroded Marlette soils. Gravel and cobblestones are scattered on the surface in many areas. Included in mapping were small areas of severely eroded Marlette soils and areas in which shallow gullies have formed. Where the subsoil is exposed, stands of plants are poor.

The effects of erosion and the hazard of further erosion make this soil unsuitable for cultivation.

This soil has been farmed intensively in the past. Now it should have a permanent cover of trees or other vegetation. (Capability unit VIe–2 (2.5a) ; woodland suitability group D)

Marlette sandy loam, 25 to 60 percent slopes, moderately eroded (MfF2).—This soil occurs as a few small areas on moraines in the central and northern parts of the county. It has short, irregular slopes that vary in gradient within short distances. The brown plow layer contains some dark yellowish-brown clay loam plowed up from the subsoil. Included in mapping were areas in which the subsoil is exposed and some in which shallow gullies have formed.

The effects of erosion and the hazard of further erosion make this soil unsuitable for cultivation.

All of the acreage has been farmed. Most of it is now idle or is gradually reforesting. Permanent vegetation is needed for protection against erosion. (Capability unit VIIe–2 (2.5a) ; woodland suitability group D)

Matherton Series

The Matherton series is made up of somewhat poorly drained, level to undulating soils on lake plains and outwash plains in the southern part of the county. These soils formed in gravelly sandy loam to loam material underlain at a depth of 24 to 42 inches with strata of sand and gravel.

In a typical profile, the surface layer is very dark grayish-brown loam about 8 inches thick. The subsurface layer, about 4 inches thick, is brown, friable loam mottled with dark brown. The subsoil is grayish-brown and light brownish-gray, firm gravelly clay loam mottled with yellowish brown and dark yellowish brown; it is about 22 inches thick. At a depth of about 34 inches is grayish-brown, loose, limy, stratified gravel and coarse sand.

Fertility is moderately high. The available water capacity is moderate; generally, the supply is adequate for optimum growth of crops. Runoff is slow, and water ponds in depressions in wet years. Permeability is moderate in the layers above the substratum. The water table is high in spring and after rain in other seasons. After they have been drained and have dried out, these soils are easy to work and to keep in good tilth.

Most of the acreage is used for crops, mainly corn, small grain, and forage crops.

Typical profile of a Matherton loam:

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) loam; weak, fine, granular structure; friable; slightly acid; abrupt, smooth boundary.

A2g—8 to 12 inches, brown (10YR 5/3) loam; few, medium, distinct, dark-brown (10YR 4/3) mottles; moderate, fine, subangular blocky structure; friable; slightly acid; clear, wavy boundary.

B21tg—12 to 17 inches, grayish-brown (10YR 5/2) light gravelly clay loam; common, medium, distinct, dark yellowish-brown (10YR 4/4) mottles; moderate, medium, subangular blocky structure; firm; medium acid; gradual, wavy boundary.

B22tg—17 to 34 inches, light brownish-gray (10YR 6/2) gravelly clay loam; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; moderate, medium, subangular blocky structure; firm; medium acid; abrupt, irregular boundary.

IIC—34 to 42 inches +, grayish-brown (10YR 5/2) stratified gravel and coarse sand; single grain; loose; calcareous.

In undisturbed areas there is a very dark grayish-brown A1 horizon 2 to 4 inches thick. The color of the Ap horizon is very dark gray in places, and the thickness of this horizon ranges from 6 to 9 inches. The depth to mottling ranges from 8 to about 16 inches. In some areas the texture of the B horizon is clay loam or gravelly sandy clay loam. The reaction of the A and B horizons ranges from medium acid to neutral.

Matherton soils have a finer textured B horizon than Wasepi soils. They differ from Macomb soils in having underlying material of gravel and sand. Matherton soils are less poorly drained and less gray than Sebewa soils. They are more poorly drained than Fox soils, which lack the mottling that is characteristic of Matherton soils.

Matherton loam, 0 to 2 percent slopes (MhA).—This soil occurs as small areas on lake plains and outwash plains throughout the county. The plow layer in some spots is sandy loam.

Excessive wetness, particularly early in the growing season, is the main limitation for farming. Drainage can be improved by means of tile and open ditches. Straw or other special blinding material is needed to keep sand from flowing into and plugging tile. Runoff is slow, so the erosion hazard is not significant.

Corn, small grain, and forage crops are important crops. (Capability unit IIw–6 (3b) ; woodland suitability group G)

Matherton loam, 2 to 6 percent slopes (MhB).—This soil occurs on outwash plains and lake plains throughout the county. The plow layer in some areas contains a little grayish-brown and dark yellowish-brown clay loam plowed up from the subsoil. In some small areas the plow layer is sandy loam.

Excessive wetness, particularly in the early part of the growing season, is the main limitation for farming. The undulating relief makes it difficult to lay out a complete drainage system, but random tile and surface drains are effective.

Corn, small grain, and forage crops are important crops. (Capability unit IIw–7 (3b) ; woodland suitability group G)

McBride Series

The McBride series is made up of well drained to moderately well drained, level to very steep soils on till plains and moraines. These soils formed in glacial material of sandy loam texture.

In a typical profile, the surface layer is dark grayish-brown sandy loam about 8 inches thick. The subsoil is about 47 inches thick. The upper 15 inches consists of yellowish-brown and pale-brown, very friable sandy loam. Below this is a 7-inch fragipan of light brownish-gray sandy loam. Below the fragipan is a 14-inch layer of dark-brown, firm sandy clay loam and then an 11-inch layer of yellowish-brown, friable loam. The underlying material, at a depth of 55 inches, is brown, friable, limy sandy loam.

Fertility is moderate, and the available water capacity is moderate. Runoff is slow to rapid, depending on the slope. Permeability is restricted in the fragipan but is moderate in the other layers. These soils dry out quickly and are ready for tillage early in spring.

The level to sloping soils of this series are used mainly for crops, including corn, oats, and hay. The steeper ones are used for pasture or have remained in woods.

Typical profile of a McBride sandy loam:

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) sandy loam; weak, fine, granular structure; very friable; slightly acid; abrupt, smooth boundary.

Bir—8 to 15 inches, yellowish-brown (10YR 5/4) sandy loam; weak, medium, granular structure; very friable; strongly acid; clear, wavy boundary.

A'21—15 to 23 inches, pale-brown (10YR 6/3) sandy loam; weak, medium, granular structure; very friable; strongly acid; clear, wavy boundary.

A'22x—23 to 30 inches, light brownish-gray (10YR 6/2) sandy loam; moderate, thick, platy structure; brittle and firm; fragipan; strongly acid; abrupt, wavy boundary.

B'21t—30 to 44 inches, dark-brown (10YR 4/3) sandy clay loam; thick coatings and tongues of light brownish-gray (10YR 6/2) A'2 material in upper part; weak, coarse, subangular blocky structure; firm; strongly acid; clear, wavy boundary.

B'22—44 to 55 inches, yellowish-brown (10YR 5/4) loam; weak, coarse, subangular blocky structure; friable; strongly acid; abrupt, wavy boundary.

C—55 to 60 inches +, brown (10YR 5/3) sandy loam; massive; friable; calcareous.

In undisturbed areas there is a very dark grayish-brown A1 horizon 2 to 4 inches thick and a brownish-gray or light-gray A2 horizon 2 to 5 inches thick. The thickness of the A and B horizons combined ranges from 40 to about 60 inches. The fragipan ranges from strong to weak in degree of development. Lenses of loamy sand occur in the C horizon in some areas. The reaction of the A horizon is dominantly strongly acid but ranges to slightly acid.

McBride soils formed in material similar to that in which Locke soils formed, but McBride soils are better drained than Locke soils and lack the mottling that is characteristic of those soils. McBride soils have a finer textured C horizon than Montcalm soils and a coarser textured C horizon than Capac soils.

McBride loamy sand, 2 to 6 percent slopes (MkB).—This soil is on till plains and low moraines in the central and northern parts of the county. Included in mapping were areas of level McBride soils.

A moderate hazard of erosion, moderate fertility, and a shortage of available water during dry periods are the main limitations for farming. The soil dries out rapidly and is ready for tillage early in spring, and it can be tilled throughout a wide range in moisture content.

Most of this soil is farmed. Corn, small grain, and forage crops are the crops commonly grown. (Capability unit IIe–3 (3a); woodland suitability group A)

McBride loamy sand, 2 to 6 percent slopes, moderately eroded (MkB2).—This soil is on till plains and low moraines in the central and northern parts of the county. It has short to medium-length slopes. Erosion has removed more than two-thirds of the original surface layer. The present plow layer is brown. It is less fertile, contains less organic matter, has poorer tilth, is more likely to crust, and absorbs less water than the plow layer of uneroded McBride soils.

Moderate hazards of erosion and blowing and a shortage of available water during dry periods are the main limitations for farming.

Most of this soil is farmed. Corn, small grain, and forage crops are commonly grown. (Capability unit IIe–3 (3a); woodland suitability group A)

McBride loamy sand, 6 to 12 percent slopes, moderately eroded (MkC2).—This soil is on moraines in the central and northern parts of the county. It has short, irregular slopes. Erosion has removed more than two-thirds of the original surface layer. The present plow layer is brown. It is less fertile, contains less organic matter, is more likely to crust, and absorbs less water than the plow layer of uneroded McBride soils. Included in mapping were small areas of less sloping and more sloping McBride soils.

The effects of erosion and the hazard of further erosion are severe limitations for farming. Contour tillage and contour stripcropping for control of erosion are not practical, because of the short, irregular slopes. A shortage of available water in dry years is another limitation.

All of this soil is cultivated or has been cultivated intensively in the past. Corn, small grain, and forage crops are commonly grown. Close-growing crops, such as wheat, grasses, and legumes, are better suited than row crops. (Capability unit IIIe–6 (3a); woodland suitability group A)

McBride sandy loam, 0 to 2 percent slopes (MlA).—This soil is on till plains in the central and northern parts of the county. Included in mapping were areas of Locke and Barry soils in drainageways. These included soils dry out more slowly than the adjoining McBride soil.

The available water capacity of this McBride soil is only moderate, and crops do not get enough moisture in dry weather. Runoff is slow, so there is little or no erosion hazard.

Nearly all of this soil is cultivated. Small grain, corn, and forage crops are common crops. (Capability unit IIs–2 (3a); woodland suitability group A)

McBride sandy loam, 2 to 6 percent slopes (MlB).—This soil is on till plains and low moraines in the central and northern parts of the county. Generally, it has uniform, medium-length slopes of 2 to 4 percent. The plow layer in some areas contains some yellowish-brown sandy loam plowed up from the subsoil. Included in mapping were areas of darker colored Locke soils in drainageways. These included soils dry out more slowly than the surrounding McBride soil.

A moderate erosion hazard is the main limitation for farming. A shortage of available water in some years is also a limitation.

Most of this soil is cultivated intensively. Small grain, corn, and forage crops are the main crops. (Capability unit IIe–3 (3a); woodland suitability group A)

McBride sandy loam, 2 to 6 percent slopes, moderately eroded (MlB2).—This soil is on till plains and low moraines in the central and northern parts of the county. It has short, variable slopes, mainly of more than 4 percent. Erosion has removed more than half the original surface layer. The present plow layer is brown or yellowish brown. It is less fertile, has a lower organic-matter content, and is more likely to crust than the plow layer of uneroded McBride soils.

A moderate hazard of further erosion is the main limitation for farming. A shortage of available water in some years is another limitation. Surface stones occur in many areas. These have to be removed before crops can be grown (fig. 12).

Most of this soil is farmed intensively. Small grain, corn, and forage crops are important crops. (Capability unit IIe–3 (3a); woodland suitability group A)

McBride sandy loam, 6 to 12 percent slopes (MlC).—This soil is on moraines in the central and northern parts of the county. It has short to medium-length slopes, some uniform and some irregular. Included in the areas mapped were small areas of a level McBride soil.

A severe hazard of erosion is the main limitation for farming. Where the slopes are uniform, runoff can be controlled and erosion checked by contour farming and contour stripcropping. Grassed waterways help to prevent gullying. Another limitation is a shortage of available water in some years.

Most of this soil is in woods. Small areas are used for hay or for pasture. (Capability unit IIIe–6 (3a); woodland suitability group A)

McBride sandy loam, 6 to 12 percent slopes, moderately eroded (MlC2).—This soil is on moraines in the central and northern parts of the county. It has short, irregular slopes. The plow layer is yellowish brown or brown. It is less friable, contains less organic matter, is more likely to crust, and absorbs less water than the plow layer of uneroded McBride soils. Included in mapping were spots of severely eroded McBride soils, in which the yellowish-brown subsoil is exposed. In these severely eroded spots, the surface crusts readily and germination of seeds is uneven and stands of plants are poor. Also included were areas in which very shallow rills have formed and areas of less sloping and more sloping McBride soils.

The effects of erosion and the severe hazard of further erosion are the main limitations for farming. Contour farming and contour stripcropping for control of erosion are not practical, because of the short, irregular slopes. Shortage of available water in some years is another limitation.

Most of this soil is farmed intensively. Small grain, corn, and forage crops are common crops. Some areas have reverted to native pasture, and some are idle. (Capability unit IIIe–6 (3a); woodland suitability group A)

McBride sandy loam, 6 to 12 percent slopes, severely eroded (MlC3).—This soil occurs as small areas on moraines in the central and northern parts of the county. It has short, irregular slopes. The plow layer is brown or yellowish brown, and in places it contains material plowed up from the subsoil. In many small areas the subsoil is exposed and eroded. Fertility is lower, the organic-matter content is less, and tilth is poorer than in uneroded McBride soils. The surface crusts readily, especially where the subsoil is exposed. Germination of seeds is uneven, and stands of plants are poor. Shallow gullies are common.

The effects of erosion and the hazard of further erosion limit the use of this soil severely.

Most of the acreage is idle or is in native pasture. Growing cover crops in most years helps to check erosion. (Capability unit IVe–6 (3a); woodland suitability group A)

McBride sandy loam, 12 to 18 percent slopes (MlD).—This soil occurs as small areas on moraines in the central and northern parts of the county. The slopes are short and irregular. Included in mapping were wet spots, areas of less sloping McBride soils on knolls and at the base of slopes, and areas of more sloping McBride soils on narrow breaks next to drainageways.

The slope and the resulting hazard of erosion severely limit the use of this soil for crops. Contour farming and contour stripcropping for control of erosion are difficult because of the short, irregular slopes. Grassed waterways help to prevent gullying.

Nearly all of this soil is in woods. A few areas are used for native pasture, hay, and orchard. (Capability unit IVe–4 (3a); woodland suitability group A)

McBride sandy loam, 12 to 18 percent slopes, moderately eroded (MlD2).—This soil occurs as small areas on moraines in the central and northern parts of the county. It has short, irregular slopes. The plow layer is yellowish brown or brown. In some areas it contains material plowed up from the subsoil. It is less fertile, contains less organic matter, absorbs less water and allows more to run off, and is more likely to crust than the plow layer of uneroded McBride soils. Included in mapping were spots of severely eroded McBride soils, in which the subsoil is exposed and gravel and cobblestones are scattered on the surface. In these severely eroded spots, germination of seeds is uneven and stands of plants are poor. Also included were areas in which shallow gullies have formed, areas of less sloping McBride soils on knolls, and areas of more sloping McBride soils on abrupt breaks in the landscape.

The effects of erosion and the hazard of further erosion severely limit the use of this soil for crops. Contour farming and contour stripcropping for control of erosion are difficult because of the short, irregular slopes. Grassed waterways help to prevent gullying.

Most of this soil has been cultivated, but many areas are now used for native pasture or are covered with brush and scattered small trees. Woods, hay, and pasture are suitable uses. (Capability unit IVe–4 (3a); woodland suitability group A)

McBride sandy loam, 12 to 18 percent slopes, severely eroded (MlD3).—This soil is on moraines in the central and northern parts of the county. It has short, irregular slopes that vary in gradient within short distances. The plow layer is brown or yellowish brown; in many areas it contains material plowed up from the subsoil. The subsoil is exposed and eroded in spots. Fertility is lower, the organic-matter content is less, and runoff is more rapid than in uneroded McBride soils. The surface crusts readily. Gravel and cobblestones are scattered over the surface. Shallow gullies are common. Germination of seeds is uneven, and stands of plants are poor. Included in

Figure 12.—Area of a McBride sandy loam. The stones were cleared from the surface to make tillage possible.

mapping were areas of slightly eroded McBride soils on knolls and hilltops.

The effects of erosion and the hazard of further erosion make this soil unsuitable for crops. Contour farming and contour stripcropping for control of erosion are impractical because of the short, irregular slopes.

All of this soil has been cultivated intensively in the past, but many areas have been abandoned and are now covered with brush and scattered small trees or are used for native pasture. Natural reforestation should be encouraged. Establishing a permanent cover of vegetation would help to check erosion. (Capability unit VIe–2 (3a); woodland suitability group A)

McBride sandy loam, 18 to 25 percent slopes, moderately eroded (MlE2).—This soil occurs as a few small areas on moraines in the central and northern parts of the county. It has short, irregular slopes that vary considerably in gradient within short distances. The plow layer is brown or yellowish brown. Fertility is lower, the organic-matter content less, the available water capacity lower, and tilth poorer than in uneroded McBride soils. Included in mapping were spots of McBride soils so severely eroded that the subsoil is exposed and a few areas in which shallow gullies have formed. Surface crusting is likely where the subsoil is exposed.

The slopes, the results of erosion, and the hazard of further erosion make this soil unsuitable for cultivated crops.

All of this soil has been cultivated in the past. Now it needs a cover of permanent vegetation for protection against erosion. Reforestation should be encouraged. (Capability unit VIe–2 (3a); woodland suitability group A)

McBride sandy loam, 25 to 60 percent slopes (MlF).—This soil occurs as small areas on moraines in the central and northern parts of the county. The slopes vary considerably in gradient within short distances. Generally, the slopes are short and irregular, but there are blufflike, uniform slopes along major drainageways and around depressions.

The slope and the erosion hazard make this soil unsuitable for any use except woods.

Most of the acreage is in woods. (Capability unit VIIe–2 (3a); woodland suitability group A)

Menominee Series

The Menominee series is made up of well drained to moderately well drained, level to moderately steep soils on lake plains, till plains, outwash plains, and moraines. These soils formed in sand or loamy sand underlain at a depth of 18 to 42 inches with loam, clay loam, or silty clay loam.

In a typical undisturbed profile, the surface layer is very dark brown loamy sand about 4 inches thick. The subsurface layer, about 2 inches thick, is light brownish-

gray, loose sand. The subsoil is about 23 inches thick. It consists of an 8-inch layer of yellowish-red, very friable loamy sand; an 8-inch layer of brown, loose sand; and a 7-inch layer of dark-brown, firm clay loam. The underlying material, at a depth of 29 inches, is brown, firm, limy loam.

Fertility is moderately low. Runoff is slow to rapid, depending on the slope. The sandy upper layers of the profile are rapidly permeable and have a moderately low available water capacity; the loamy lower layers are moderately slowly permeable and hold enough water to keep the upper layers moist.

Many of the nearly level and gently sloping areas are used for crops. The steeper ones are in woods or pasture.

Typical profile of a Menominee loamy sand:

A1—0 to 4 inches, very dark brown (10YR 2/2) loamy sand; weak, fine, granular structure; very friable; slightly acid; abrupt, smooth boundary.

A2—4 to 6 inches, light brownish-gray (10YR 6/2) sand; single grain; loose; medium acid; clear, irregular boundary.

Bir—6 to 14 inches, yellowish-red (5YR 4/6) loamy sand; very weak, medium, subangular blocky structure; very friable; medium acid; abrupt, smooth boundary.

A'2—14 to 22 inches, brown (10YR 5/3) sand; single grain; loose; medium acid; abrupt, irregular boundary.

IIB't—22 to 29 inches, dark-brown (10YR 4/3) clay loam; thick coatings of A'2 material on ped faces and in cracks and channels; strong, medium, subangular blocky structure; firm; mildly alkaline; abrupt, wavy boundary.

IIC—29 to 42 inches +, brown (10YR 5/3) loam; weak, medium, platy structure; firm; calcareous.

In cultivated areas there is a very dark grayish-brown Ap horizon 6 to 9 inches thick. Some profiles lack an A2 horizon. The texture of the IIB't horizon is heavy loam or silty clay loam in many areas, and the thickness of this horizon ranges from 3 to 10 inches. In some areas the texture of the C horizon is clay loam or silty clay loam. The reaction of the sandy layers above the IIB't horizon is medium acid to slightly acid, and that of the IIB't horizon is slightly acid to mildly alkaline.

Menominee soils are coarser textured in the upper part of the B horizon than Ubly or Owosso soils. They formed in material similar to that in which Iosco soils formed, but they are better drained than Iosco soils and are not mottled.

Menominee loamy sand, 0 to 2 percent slopes (MmA).—This soil is on plains. Where cultivated, it has a very dark grayish-brown plow layer. Included in mapping were areas of the darker colored Iosco soils in drainageways and other depressions. These included soils dry out more slowly than the surrounding Menominee soil. Also included were a few areas of gently sloping Menominee soils.

A shortage of available water during the growing season is the main limitation for farming. Soil blowing is a hazard if large areas are left bare of vegetation.

Most of this soil is farmed. Small grain and forage crops are the crops commonly grown. (Capability unit IIIs–3 (4/2a); woodland suitability group C)

Menominee loamy sand, 2 to 6 percent slopes (MmB).—This soil is on plains and low moraines. Where cultivated it has a very dark grayish-brown plow layer. Included in mapping were areas of the darker colored Iosco soils in narrow drainageways and depressions. These included soils dry out more slowly than the surrounding Menominee soil. Also included were small areas of level Menominee soils.

A shortage of available water during the growing season is the main limitation for farming.

Most of this soil is farmed. Small grain and forage crops are the crops commonly grown. (Capability unit IIIs–4 (4/2a); woodland suitability group C)

Menominee loamy sand, 6 to 12 percent slopes (MmC).—This soil is on low moraines. It has short slopes, some uniform and some irregular. The plow layer in cultivated areas is brown. Included in mapping were small areas of moderately eroded Menominee soils.

An erosion hazard and a shortage of available water during the growing season are the main limitations for farming.

Small grain and forage crops are the crops commonly grown. (Capability unit IIIe–9 (4/2a); woodland suitability group C)

Menominee loamy sand, 12 to 18 percent slopes (MmD).—This soil is on moraines. It has short, irregular slopes that vary considerably in gradient within short distances. The plow layer is brown. In most areas it contains a little yellowish-red loamy sand plowed up from the subsoil. Included in mapping were large areas from which more than half the original surface layer has been removed by erosion. Also included were small areas of gently sloping and sloping Menominee soils.

The slope, the erosion hazard, and a shortage of available water are severe limitations for farming.

Most of this soil has been farmed intensively, but now much of it is idle. A cover of permanent vegetation would help to check erosion. (Capability unit IVe–9 (4/2a); woodland suitability group C)

Metamora Series

The Metamora series is made up of somewhat poorly drained, level to undulating soils on till plains. These soils formed in sandy loam or heavy loamy sand underlain at a depth of 18 to 42 inches with loam or light clay loam.

In a typical profile, the surface layer is very dark grayish-brown sandy loam about 10 inches thick. The subsurface layer, about 16 inches thick, is pale-brown, very friable sandy loam mottled with yellowish brown. The subsoil is about 22 inches thick. The upper 6 inches is grayish-brown, friable light loam mottled with yellowish brown, and the lower 16 inches is light-gray, firm clay loam mottled with dark yellowish brown. The substratum, at a depth of about 48 inches, is light-gray, firm, limy loam mottled with dark yellowish brown and olive brown.

Fertility is moderate, and the available water capacity is moderate. Permeability is moderate to moderately slow. Runoff is slow, and water ponds in level areas and depressions. The water table is high in spring and during wet weather in other seasons. After these soils have been drained and have dried out, they are easy to work.

Most areas of these soils are used for crops, including corn, oats, and hay. A few areas are in permanent pasture, and a few are in woods.

Typical profile of a Metamora sandy loam:

Ap—0 to 10 inches, very dark grayish-brown (10YR 3/2) sandy loam; weak, medium, granular structure; friable; medium acid; abrupt, smooth boundary.

A2—10 to 26 inches, pale-brown (10YR 6/3) sandy loam; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; weak, medium, subangular blocky structure; very friable; medium acid; gradual, wavy boundary.

B21g—26 to 32 inches, grayish-brown (10YR 5/2) light loam; many, medium, distinct, yellowish-brown (10YR 5/4) mottles; weak, medium, subangular blocky structure; friable; medium acid; abrupt, smooth boundary.

IIB22tg—32 to 48 inches, light-gray (10YR 6/1) clay loam; many, coarse, distinct, dark yellowish-brown (10YR 4/4) mottles; moderate, medium, subangular blocky structure; firm; slightly acid; abrupt, smooth boundary.

IICg—48 to 60 inches +, light-gray (10YR 6/1) loam; many, coarse, distinct, dark yellowish-brown (10YR 4/4) and olive-brown (2.5Y 4/4) mottles; massive; firm; calcareous.

In undisturbed areas, there is a very dark gray A1 horizon 2 to 4 inches thick. The thickness of the A horizon ranges from 20 to 40 inches. In some areas the texture of the lower part of the B horizon is silty clay loam. The reaction of the A and B horizons ranges from medium acid to neutral.

Metamora soils are coarser textured in the upper part of the B horizon than Conover soils. They formed in material similar to that in which Owosso soils formed, but Metamora soils are more poorly drained than Owosso soils, which lack the mottling that is characteristic of Metamora soils.

Metamora sandy loam, 0 to 2 percent slopes (MnA).—This soil is on till plains in the southern part of the county.

Excessive wetness early in spring and an occasional shortage of available water during dry weather are the main limitations for farming. Tile drainage is needed for efficient production of crops.

Most of this soil is farmed along with adjoining soils. Corn, small grain, and forage crops are grown. (Capability unit IIw–8 (3/2b); woodland suitability group G)

Metamora sandy loam, 2 to 6 percent slopes (MnB).—This soil is on till plains in the southern part of the county. It has short to medium, uniform slopes. In some areas the plow layer contains material plowed up from the subsoil. Included in mapping were a few areas of level Metamora soils.

Excessive wetness early in spring is the main limitation for farming. Installing a complete drainage system is difficult because of undulating relief.

If drained, this soil is suited to corn, small grain, and forage crops. Most of the acreage is farmed intensively. (Capability unit IIw–8 (3/2b); woodland suitability group G)

Miami Series

The Miami series is made up of well-drained, gently sloping to very steep soils on till plains and moraines. These soils formed in loamy material.

In a typical profile, the surface layer is dark grayish-brown loam about 8 inches thick. The subsurface layer, about 4 inches thick, is yellowish-brown, friable loam. The subsoil is dark-brown and yellowish-brown, firm clay loam about 24 inches thick. The substratum, at a depth of about 36 inches, is brown, friable, limy loam.

Fertility is high, and the available water capacity is high. Permeability is moderately slow. Runoff is slow to rapid, depending on the slope. These soils dry out quickly and are ready for tillage early in spring.

Gently sloping and moderately sloping soils of this series can be farmed intensively if protected against erosion. Corn, small grain, and forage crops are the main crops. The steeper soils and any areas not protected against erosion are better suited to woods or pasture.

Typical profile of a Miami loam:

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) loam; moderate, medium, granular structure; friable; slightly acid; abrupt, smooth boundary.

A2—8 to 12 inches, yellowish-brown (10YR 5/4) loam; moderate, coarse, granular structure; friable; medium acid; clear, wavy boundary.

B21t—12 to 29 inches, dark-brown (10YR 4/3) clay loam; moderate, medium, subangular blocky structure; firm; medium acid; gradual, wavy boundary.

B22t—29 to 36 inches, yellowish-brown (10YR 5/4) clay loam; moderate, medium, subangular blocky structure; firm; slightly acid; abrupt, wavy boundary.

C—36 to 48 inches +, brown (10YR 5/3) loam; weak, coarse, subangular blocky structure; friable; calcareous.

In areas not yet farmed, there is a very dark grayish-brown A1 horizon 2 to 4 inches thick. The color of the Ap horizon ranges from very dark grayish brown to brown, and the texture from sandy loam to clay loam. The B horizon in some areas consists of dark yellowish-brown silty clay loam. The thickness of the A and B horizons combined ranges from 24 to about 42 inches. In a few areas the texture of the C horizon is silt loam or light clay loam. The reaction of the A and B horizons is dominantly medium acid to slightly acid but ranges to strongly acid.

Miami soils are better drained than either Celina or Conover soils, and they lack the mottling that is characteristic of those soils. They have finer textured underlying material than either Lapeer or McBride soils.

Miami loam, 2 to 6 percent slopes (MoB).—This soil is on till plains and low moraines. On the uplands, the slopes are uniform and are short to medium in length; on the till plains, the slopes are undulating and are of medium length. The plow layer is dark grayish-brown or dark-brown loam or sandy loam. Included in mapping were areas of Celina and Conover soils in swales and other depressions and also a few small areas of moderately eroded Miami soils.

This soil is well suited to crops. A moderate erosion hazard is the main limitation for farming.

Most of the acreage is farmed intensively. Corn, small grain, and forage crops are the most important crops. (Capability unit IIe–2 (2.5a); woodland suitability group D)

Miami loam, 2 to 6 percent slopes, moderately eroded (MoB2).—This soil is on till plains and low moraines. It has uniform, short to medium slopes. About half of the material above the subsoil has been removed by erosion. The present plow layer is brown loam or sandy loam. It contains a little dark-brown clay loam plowed up from the subsoil. It is less fertile, contains less organic matter, and crusts more readily than the plow layer of uneroded Miami soils. Included in mapping were a few small areas of severely eroded Miami soils having a slope range of 4 to 6 percent.

This soil is well suited to crops. A moderate hazard of further erosion and the poor tilth resulting from past erosion are the main limitations for farming.

Most of the acreage is farmed intensively. Corn, small grain, and forage crops are the most important crops. (Capability unit IIe–2 (2.5a); woodland suitability group D)

Miami loam, 6 to 12 percent slopes (MoC).—This soil is on moraines. The slopes are generally short and are uniform in some areas and irregular in others. The plow layer is dark-brown loam or sandy loam. Included in mapping were small areas of moderately eroded Miami soils.

The hazard of erosion is a severe limitation for farming. Contour tillage and contour stripcropping are not practical for the areas where the slopes are irregular. A cropping sequence that includes grasses and legumes helps to control runoff and check erosion in such areas.

Most of this soil is in woods or is used for hay or pasture. Corn and small grain are the main cultivated crops. (Capability unit IIIe–5 (2.5a); woodland suitability group D)

Miami loam, 6 to 12 percent slopes, moderately eroded (MoC2).—This soil is on moraines. It has short to medium, uniform to irregular slopes. About half the original surface layer has been removed by erosion. The present plow layer is brown loam or sandy loam. It contains a little material plowed up from the subsoil. It is less fertile, contains less organic matter, has poorer tilth, crusts more readily, and contains more gravel than the plow layer of uneroded Miami soils. Included in mapping were a few areas of Miami soils so severely eroded that the clay loam subsoil is exposed and gravel and cobblestones are scattered on the surface. In these severely eroded spots, germination of seeds is uneven and stands of plants are poor. Areas of less sloping Miami soils also were included.

Although the hazard of further erosion is severe, this soil is widely used for crops. Contour tillage and contour stripcropping for control of erosion are impractical where the slopes are short and irregular. Poor tilth and a tendency to crust are additional limitations.

Most of this soil is cultivated. Corn, small grain, and forage crops are the main crops. (Capability unit IIIe–5 (2.5a); woodland suitability group D)

Miami loam, 12 to 18 percent slopes (MoD).—This soil is on moraines. It has short, irregular slopes. The surface layer is very dark grayish-brown loam or sandy loam. Included in mapping were areas of less sloping Miami soils on hills and knolls and of steeper Miami soils next to drainageways and depressions.

The slope and the erosion hazard severely limit the use of this soil for crops. Stripcropping is impractical in many areas because of the short, complex slopes, but a cropping sequence that consists largely of close-growing crops helps to check runoff and control erosion.

This soil is better suited to pasture and woods than to row crops. Nearly all the acreage is in woods. Small areas are covered with brush, and others are used for pasture. (Capability unit IVe–4 (2.5a); woodland suitability group D)

Miami loam, 12 to 18 percent slopes, moderately eroded (MoD2).—This soil is on moraines. It has short, irregular slopes. Erosion has removed all but 3 to 5 inches of the original surface layer. Parts of some areas have a plow layer of brown loam or sandy loam that also contains a little clay loam plowed up from the subsoil. The present surface layer is less fertile, contains less organic matter, has poorer tilth, crusts more readily, and contains more gravel than the surface layer of uneroded Miami soils. Included in mapping were small areas of severely eroded Miami soils that have gravel and cobblestones scattered on the surface. In these severely eroded spots, germination of seeds is uneven and stands of plants are poor. Other inclusions are areas in which a few shallow gullies have formed, areas of less sloping and of steeper Miami soils, and a few areas of stratified silt and very fine sand.

The slope, the effects of erosion, and the hazard of further erosion severely limit the use of this soil for crops. Contour tillage and contour stripcropping for control of erosion are impractical because of the short, irregular slopes.

All of this soil has been cultivated in the past. Now most of it is in forage crops or pasture. Small areas are still used for corn and small grain. (Capability unit IVe–4 (2.5a); woodland suitability group D)

Miami loam, 18 to 25 percent slopes (MoE).—This soil occurs as small areas on moraines. It has short, irregular slopes that vary considerably in gradient within short distances. The areas commonly consist of several steep hills and the drainageways and other low, wet areas between the hills. The surface layer is very dark grayish-brown loam or sandy loam. Included in mapping were areas of less sloping Miami soils on hilltops and at the base of slopes and areas of steeper Miami soils on bluff-like formations.

The slope and the very severe hazard of erosion make this soil unsuitable for cultivated crops.

Most of the acreage is in woods. All of it should be kept in permanent vegetation. (Capability unit VIe–2 (2.5a); woodland suitability group D)

Miami loam, 18 to 25 percent slopes, moderately eroded (MoE2).—This soil occurs as small areas on moraines. It has short, irregular slopes that vary considerably in gradient within short distances. The areas commonly consist of several small steep hills and the drainageways and other low, wet areas between the hills. The plow layer is brown heavy loam or sandy loam. In some areas it contains a little clay loam plowed up from the subsoil. It is less fertile, contains less organic matter, has poorer tilth, crusts more readily, and contains more gravel than the plow layer of uneroded Miami soils. Included in mapping were spots of severely eroded Miami soils in which the subsoil is exposed, gravel and cobblestones are scattered on the surface, and shallow gullies have formed. In these severely eroded spots, germination of seeds is uneven and stands of plants are poor. Also included in mapping were areas of less sloping and of steeper Miami soils.

The slope, the effects of erosion, and the hazard of further erosion severely limit the use of this soil.

All of the acreage has been cleared and cultivated in the past. Now a cover of trees or other permanent vegetation should be established. (Capability unit VIe–2 (2.5a); woodland suitability group D)

Miami loam, 25 to 60 percent slopes (MoF).—This soil is on moraines. The slopes vary considerably in gradient within short distances. Generally, they are short and irregular, but very short, uniform slopes occur as bluffs along major drainageways and around large lakes. In some areas the surface layer is sandy loam. Included in mapping were areas of less sloping Miami soils and a few areas in which the subsoil is clay and the underlying material is silty clay loam or clay loam.

The slope, the rough topography, and the erosion hazard make this soil unsuitable for farming.

This soil needs a cover of trees or other permanent vegetation. Most of the acreage is in woods. (Capability unit VIIe–2 (2.5a); woodland suitability group D)

Miami loam, 25 to 60 percent slopes, moderately eroded (MoF2).—This soil occurs as a few small areas on moraines. The slopes vary considerably in gradient within short distances. Generally the slopes are short and irregular, but very short, uniform slopes occur in a few places as bluffs along major drainageways and around large areas of muck. The plow layer is brown loam or sandy loam. In some areas it contains a little clay loam plowed up from the subsoil. Included in mapping were areas in which the subsoil of dark-brown clay loam is exposed and some areas in which shallow gullies are forming.

The slope, the effects of erosion, and the hazard of further erosion make this soil unsuitable for farming.

All of this soil has been cultivated in the past. Now most of it is in native pasture or is gradually being planted to trees. All of it needs permanent vegetation. (Capability unit VIIe–2 (2.5a); woodland suitability group D)

Miami clay loam, 6 to 12 percent slopes, severely eroded (MpC3).—This soil occurs as small areas on moraines. It has short, irregular slopes. Most of the original surface layer has been removed by erosion, and in many places the subsoil is exposed. The plow layer is brown. It is less fertile, contains less organic matter, and has poorer tilth than the original surface layer. It puddles if worked when too wet and then crusts upon drying. The crusting results in increased runoff and continued erosion. Germination of seeds is uneven, and stands of plants are poor. Shallow gullies are forming in some areas, mainly in former drainageways.

The results of erosion and a severe hazard of further erosion severely limit the use of this soil for crops.

All of this soil has been intensively cultivated. Close-growing crops are more suitable for it than row crops. To check erosion, a cover of close-growing vegetation should be maintained most of the time. (Capability unit IVe–5 (2.5a); woodland suitability group D)

Miami clay loam, 12 to 18 percent slopes, severely eroded (MpD3).—This soil occurs as small areas on moraines. It has short, irregular slopes. Most of the original surface layer has been removed by erosion. The plow layer is brown. It is less fertile, contains less organic matter, and has less capacity to absorb water than the original surface layer. It puddles if worked when wet and crusts and clods upon drying. The crusting results in increased runoff and continued erosion. Germination of seeds is uneven, and stands of plants are poor. Shallow gullies are numerous in some areas. The depth to the limy underlying material is generally less than 30 inches.

The slope, the effects of erosion, and the hazard of further erosion severely limit the use of this soil for crops.

All of this soil has been intensively cultivated in the past. Pasture and forage are suitable uses for it at present. Some areas should be reforested. (Capability unit VIe–2 (2.5a); woodland suitability group D)

Miami clay loam, 18 to 25 percent slopes, severely eroded (MpE3).—This soil occurs as small areas on moraines. It has short, irregular slopes that vary considerably in gradient within short distances. The plow layer is brown. In many areas the dark-brown subsoil is exposed. Shallow gullies are common, and deep gullies occur in some areas. The depth to the limy underlying material is generally less than 30 inches.

The slope, the effects of erosion, and the hazard of further erosion make this soil unsuitable for crops.

This soil has been cultivated in the past, but most of it is now covered with native grass, brush, and small trees. Permanent vegetation is needed. Natural reforestation should be encouraged. (Capability unit VIIe–2 (2.5a); woodland suitability group D)

Miami clay loam, 25 to 60 percent slopes, severely eroded (MpF3).—This soil occurs as small areas on moraines. It has short, irregular slopes that vary considerably in gradient within short distances. The plow layer is brown. Over much of the acreage, the dark-brown subsoil is exposed. Shallow gullies are common, and some deep gullies occur. The depth to the limy underlying material is generally less than 30 inches. Included in mapping were areas in which the subsoil is clay and the underlying material is silty clay loam or clay loam.

The slope, the effects of erosion, and the hazard of further erosion make this soil unsuitable for crops.

All of this soil has been cultivated in the past, but most of it has been abandoned. Native grass, brush, and scattered small trees now cover most areas. Permanent vegetation is needed. Natural reforestation should be encouraged. (Capability unit VIIe–2 (2.5a); woodland suitability group D)

Montcalm Series

The Montcalm series is made up of well drained and moderately well drained, level to very steep soils on outwash plains and moraines. These soils formed in material of loamy sand and sand texture.

In a typical profile, the surface layer is brown loamy sand about 11 inches thick. The subsurface layer, also about 11 inches thick, is very pale brown, very friable loamy sand. The upper 7 inches of the subsoil is dark yellowish-brown, friable sandy loam. Below this is a 12-inch banded layer of yellowish-brown, loose loamy sand and strong-brown, friable fine sandy loam, and below this, another banded layer, 13 inches thick, that consists of light yellowish-brown, loose sand and strong-brown, very friable loamy fine sand. The underlying material, at a depth of about 54 inches, is light-gray, loose, limy fine sand.

The available water capacity is moderately low; crops do not usually get enough moisture for optimum growth through dry periods in the growing season. Permeability is moderately rapid. Runoff is slow to medium, depending on the slope. The organic-matter content is low.

The level to sloping soils of this series are used for crops. Some areas of the steeper soils are in woods or pasture, and some are idle and growing up to brush.

Typical profile of a Montcalm loamy sand:

Ap—0 to 11 inches, brown (10YR 4/3) loamy sand; weak, fine, granular structure; very friable; medium acid; abrupt, smooth boundary.

A2—11 to 22 inches, very pale brown (10YR 7/4) loamy sand; weak, medium, granular structure; very friable; medium acid; gradual, wavy boundary.

A2—11 to 22 inches, very pale brown (10YR 7/4) loamy sand; loam; weak, medium, granular structure; friable; slightly acid; gradual, wavy boundary.

A'21&B'21—29 to 41 inches, a banded zone that contains a sequence of A'2 and B'2 horizons. The B'2 horizons vary between ¼ and 1 inch in thickness, and the A'2 horizons between 1 inch and 6 inches. The B'2 horizons are continuous and more or less parallel. The A'2 horizons are yellowish-brown (10YR 5/6) loamy sand; single grain; loose; slightly acid; abrupt, wavy boundary. The B'2 horizons consist of strong-brown (7.5YR 5/6) fine sandy loam; weak, fine, subangular blocky structure; friable; slightly acid; abrupt, wavy boundary.

A'22&B'22—41 to 54 inches, a broken banded zone that contains a sequence of A'2 and B'2 horizons. The B'2 horizons vary between less than 1/16 inch and ¼ inch in thickness, and the A'2 horizons between 4 and 9 inches. Many of the B'2 horizons are discontinuous. These horizons are more or less parallel. The A'2 horizons consist of light yellowish-brown (10YR 6/4) sand; single grain; loose; neutral; abrupt, wavy boundary. The B'2 horizons consist of strong-brown (7.5YR 5/6) loamy fine sand; massive; very friable; neutral; abrupt, wavy boundary.

C—54 to 60 inches +, light-gray (10YR 7/1) fine sand; single grain; loose; calcareous.

In areas not yet cultivated, there is a very dark grayish-brown A1 horizon about 4 inches thick and an A2 horizon of light-gray loamy fine sand about 1 inch thick. The thickness of the A and B horizons combined ranges from 42 to about 72 inches. The reaction of the A and B horizons ranges from medium acid to neutral, and that of the C horizon from slightly acid to mildly alkaline.

Montcalm soils have B' horizons closer to the surface than Chelsea soils do. They are better drained than Tedrow soils and lack the mottling that is characteristic of Tedrow soils.

Montcalm loamy sand, 0 to 2 percent slopes (MrA).—This soil occurs mainly on outwash plains in the central and northern parts of the county. Included in a few of the areas mapped are poorly drained swales and wet depressions. Also included are areas that have been slightly affected by soil blowing.

This soil dries out quickly in spring, and it is easy to work. A shortage of available water during the summer months is the main limitation for farming. Water erosion is not a significant hazard, but soil blowing can do serious damage to areas that are intensively farmed.

Most of this soil is farmed. Corn, small grain, and forage crops are grown. (Capability unit IIIs–3 (4a); woodland suitability group M)

Montcalm loamy sand, 2 to 6 percent slopes (MrB).—This soil is on outwash plains and moraines in the central and northern parts of the county. On the uplands, the slopes are short to medium; on the terraces and outwash plains, the slopes are long and undulating.

This soil can be worked easily throughout a wide range of moisture content without clodding or crusting. A shortage of available water in midsummer is the main limitation for farming. Runoff is slow, and water erosion is not a serious hazard. Soil blowing can damage cultivated areas, and the hazard increases if the organic-matter content is reduced by excessive tillage.

This soil is used for small grain, corn, forage crops, and pasture. (Capability unit IIIs–4 (4a); woodland suitability group M)

Montcalm loamy sand, 6 to 12 percent slopes (MrC).—This soil is on moraines in the central and northern parts of the county. It has short, irregular slopes. Where organic matter has accumulated, the surface layer is very dark grayish brown to a depth of several inches. Included in mapping were small areas of moderately eroded Montcalm soils.

Both water erosion and soil blowing are hazards that limit the use of this soil. A shortage of available water slows the growth of crops in midsummer.

Much of this soil is in woods or native pasture. Most cultivated areas are used for small grain, forage, or pasture. (Capability unit IIIe–9 (4a); woodland suitability group M)

Montcalm loamy sand, 12 to 18 percent slopes (MrD).—This soil occurs as small areas on moraines in the northern part of the county. It has short, irregular slopes that vary considerably within short distances. Included in mapping were small areas of less sloping Montcalm soils.

Runoff is medium to moderately rapid, and erosion is a very severe hazard in areas where crops are grown. A shortage of available water slows the growth of crops in midsummer in most years.

This soil is mostly in woods. It needs a cover of permanent vegetation, which would help to control erosion and also provide forage for livestock. (Capability unit IVe–9 (4a); woodland suitability group M)

Montcalm loamy sand, 18 to 25 percent slopes (MrE).—This soil is on moraines in the central and northern parts of the county. It has short, irregular slopes that vary considerably in gradient within short distances. Included in mapping were small areas of less sloping Montcalm soils and of moderately eroded Montcalm soils.

The slope, the erosion hazard, and a shortage of available water make this soil unsuitable for cultivated crops.

Nearly all of the acreage is in woods. A cover of trees or other permanent vegetation should be maintained for protection against erosion. (Capability unit VIe–2 (4a); woodland suitability group M)

Montcalm loamy sand, 25 to 50 percent slopes (MrF).—This soil is on moraines in the central and northern parts of the county. It has short, irregular slopes that vary considerably in gradient within short distances. Very short, uniform slopes form bluffs along some of the major drainageways and around large bodies of water.

This soil is too steep, too droughty, and too readily eroded to be used for crops, and it is poorly suited to forage crops because the slope makes seeding difficult.

Nearly all of the acreage is in woods. A cover of trees or other permanent vegetation should be maintained at all times. (Capability unit VIIe–2 (4a); woodland suitability group M)

Montcalm sandy loam, 0 to 2 percent slopes (MsA).—This soil occurs as small areas on outwash plains in the northern part of the county.

A shortage of available water is the main limitation for farming. Water erosion is not a serious hazard, but soil blowing can cause damage to large areas that are left bare of vegetation.

Most of this soil is intensively farmed. Corn, small grain, and forage crops are the main crops. (Capability unit IIIs–3 (4a); woodland suitability group M)

Montcalm sandy loam, 2 to 6 percent slopes (MsB).—This soil occurs as small areas on outwash plains and low moraines in the northern part of the county. Included in mapping were small areas of moderately eroded Montcalm soils.

A shortage of available water limits the growth of crops on this soil.

Most of the acreage is farmed intensively. Corn, small grain, and forage crops are grown. (Capability unit IIIs–4 (4a); woodland suitability group M)

Morley Series

The Morley series is made up of well drained to moderately well drained, gently sloping to steep soils on till plains and moraines. These soils formed in glacial material of clay loam or silty clay loam texture.

In a typical profile, the surface layer is dark grayish-brown loam about 8 inches thick. The subsurface layer, about 2 inches thick, is pale-brown, friable loam. The subsoil is about 17 inches thick. The upper 10 inches is brown, firm light clay. The lower 7 inches is yellowish-brown, firm heavy clay loam mottled with pale brown and dark brown. The underlying material, at a depth of about 27 inches, is light brownish-gray, firm, limy clay loam.

Fertility is moderately high, and the available water capacity is high. Permeability is moderately slow. Runoff varies, depending on the slope.

Most areas of the gently sloping to sloping soils of this series are farmed intensively. The steeper soils are in pasture or in woods.

Typical profile of a Morley loam:

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) loam; moderate, medium, granular structure; friable; medium acid; abrupt, smooth boundary.

A2—8 to 10 inches, pale-brown (10YR 6/3) loam; weak, medium, platy structure; friable; medium acid; clear, wavy boundary.

B21t—10 to 20 inches, brown (10YR 5/3) light clay; moderate, coarse, angular blocky structure; firm; medium acid; gradual, wavy boundary.

B22t—20 to 27 inches, yellowish-brown (10YR 5/4) heavy clay loam; few, medium, distinct, pale-brown (10YR 6/3) and dark-brown (7.5YR 4/2) mottles; strong, medium, angular blocky structure; firm; slightly acid; abrupt, wavy boundary.

C—27 to 42 inches +, light brownish-gray (10YR 6/2) clay loam; weak, medium, angular blocky structure; firm; calcareous.

In areas not yet farmed, there is a very dark brown or very dark grayish-brown A1 horizon 2 to 4 inches thick. The color of the Ap horizon in some areas is grayish brown or brown. In a few areas the texture of the C horizon is silty clay loam, and the color is pale brown or brown. The depth to the C horizon ranges from 20 to 36 inches in the gently sloping soils, but it is less than 20 inches in a few areas of the sloping to steep soils. The reaction of the A and B horizons ranges from medium acid to slightly acid.

Morley soils are better drained and lighter colored than Blount soils. They have coarser textured underlying material and are better drained than Roselms soils. They are finer textured in the upper part of the B horizon and in the C horizon than Miami or Celina soils.

Morley loam, 2 to 6 percent slopes (MtB).—This soil is on till plains and moraines throughout the county. It has short, uniform slopes. The plow layer in some areas is brown. Included in mapping were small areas of level Morley soils and of moderately eroded Morley soils. Also included were areas of Blount soils in drainageways and other low spots. These included areas of Blount soils dry out more slowly than the surrounding Morley soil.

A moderate hazard of erosion is the main limitation for farming.

Most of this soil is intensively farmed. Corn, small grain, and forage crops are common crops. (Capability unit IIe–1 (1.5a); woodland suitability group B)

Morley loam, 2 to 6 percent slopes, moderately eroded (MtB2).—This soil is on till plains and moraines throughout the county. It has short to medium slopes, predominantly of 4 to 6 percent. The plow layer is brown. In most areas it contains a small amount of finer textured material plowed up from the subsoil. It is less fertile, contains less organic matter, and crusts more readily than the plow layer of uneroded Morley soils. Included in mapping were small spots of severely eroded Morley soils, in which the subsoil is exposed. Also included were areas of Blount soils in narrow drainageways. These included areas of Blount soils dry out more slowly than the surrounding Morley soils.

The hazard of further erosion is the main limitation for farming. Poor tilth and crusting, resulting from past erosion, are additional limitations.

All of this soil is farmed intensively. Corn and small grain are important crops. Alfalfa and other forage crops also are grown extensively. (Capability unit IIIe–3 (1.5a); woodland suitability group B)

Morley loam, 6 to 12 percent slopes (MtC).—This soil is on moraines throughout the county. It has short to medium-length, uniform to somewhat irregular slopes. Included in mapping were areas of Blount and Pewamo soils in drainageways, small depressions, and seepage areas. These included soils dry out more slowly than the surrounding Morley soil. Also included were small areas of level Morley soils.

The hazard of erosion is the main limitation for farming. Contour tillage and contour stripcropping, which would help to control erosion, are not practical in the areas where the slopes are short and irregular.

Most areas of this soil are in woods. (Capability unit IIIe–4 (1.5a); woodland suitability group B)

Morley loam, 6 to 12 percent slopes, moderately eroded (MtC2).—This soil is on moraines throughout the county. It has short to medium-length, uniform to somewhat irregular slopes. The present plow layer is brown. In most areas it contains a little material plowed up from the subsoil. It is less fertile, contains less organic matter, has poorer tilth, crusts more readily, and contains more gravel than the plow layer of uneroded Morley soils. Included in mapping were a few spots of Morley soils so severely eroded that the subsoil is exposed.

The hazard of further erosion is the main limitation for farming. Contour tillage and contour stripcropping, which would help to control erosion, are not practical where the slopes are short and irregular. Poor tilth and a tendency to crust limit the use of parts of some areas.

All of this soil has been farmed. Corn, small grain, and forage crops are grown. (Capability unit IIIe–4 (1.5a); woodland suitability group B)

Morley loam, 12 to 18 percent slopes, moderately eroded (MtD2).—This soil is on moraines throughout the county. It has short, irregular slopes. More than half the original surface layer has been removed by erosion. The present plow layer is brown heavy loam. In most areas it contains a little material plowed up from the subsoil. It is less fertile, contains less organic matter, has poorer tilth, crusts more readily, and contains more gravel than the plow layer of uneroded Morley soils. Included in

mapping were spots of severely eroded Morley soils, in which the subsoil is exposed and gravel and cobblestones are scattered on the surface. In some included areas, shallow gullies have formed. Other inclusions are areas of less sloping Morly soils on hills and knolls, of steeper Morley soils next to drainageways and depressions, and of Blount and Pewamo soils in drainageways, depressions, and seepage areas.

The hazard of further erosion is the main limitation for farming. Contour tillage and contour stripcropping, which help to control erosion, are not practical because of the short, irregular slopes. Poor tilth and a tendency to crust limit the use of parts of some areas.

All of this soil has been cultivated, but many areas are now in pasture and others are growing up in brush. Close-growing vegetation, which helps to check runoff and control erosion, should be maintained most of the time. (Capability unit IVe–4 (1.5a); woodland suitability group B)

Morley clay loam, 6 to 12 percent slopes, severely eroded (MuC3).—This soil occurs as small areas on moraines throughout the county. It has short, irregular slopes. The brown plow layer is a mixture of subsoil material and what remains of the original surface layer. It is less fertile, contains less organic matter, and has poorer tilth than the plow layer of uneroded Morley soils. It puddles if worked when too wet and then crusts and cracks when it dries out. Germination of seeds is uneven, and stands of plants are poor. In some areas the subsoil is exposed, and a few of the natural drainageways are gullied.

The main limitations of this soil are the very severe hazard of further erosion and the poor tilth that has resulted from past erosion.

All of this soil has been intensively cultivated, but now much of it is in native pasture or in brush. Close-growing crops, which help to check runoff, are better suited than row crops. (Capability unit IVe–5 (1.5a); woodland suitability group B)

Morley clay loam, 12 to 18 percent slopes, severely eroded (MuD3).—This soil occurs as small areas on moraines throughout the county. It has short, irregular slopes. The brown plow layer is a mixture of subsoil material and what remains of the original surface layer. It is less fertile, contains less organic matter, and has poorer tilth than the plow layer of uneroded Morley soils. It puddles if worked when too wet and then crusts as it dries out. Germination of seeds is uneven, and stands of plants are poor. Shallow gullies have formed in some areas. The depth to the limy substratum is commonly less than 20 inches.

The slope, the effects of erosion, and the hazard of further erosion make this soil unsuitable for cultivated crops.

All of this soil has been intensively cultivated in the past, but now much of it is covered with brush, native grasses, and weeds. Permanent vegetation, which helps to check runoff, should be maintained. (Capability unit VIe–2 (1.5a); woodland suitability group B)

Morley clay loam, 18 to 25 percent slopes, severely eroded (MuE3).—This soil occurs as small areas on moraines throughout the county. It has short, irregular slopes. The brown surface layer is a mixture of subsoil material and what remains of the original surface layer. Shallow gullies have formed in some areas. The depth to the limy substratum is commonly less than 20 inches.

The slope, the effects of erosion, and the hazard of further erosion make this soil unsuitable for crops.

This soil has been cultivated in the past, but now most of it is in native grass, brush, and scattered small trees. It needs to be covered with permanent vegetation. Natural reforestation should be encouraged. (Capability unit VIIe–2 (1.5a); woodland suitability group B)

Munuscong Series

The Munuscong series is made up of poorly drained, nearly level or depressional soils on lake plains. These soils formed in sandy loam or fine sandy loam underlain at a depth of 18 to 42 inches with clay or silty clay.

In a typical profile, the surface layer is black sandy loam about 6 inches thick. The subsoil, about 24 inches thick, consists of grayish-brown, light-gray, and light brownish-gray, friable to very friable sandy loam mottled with yellowish-brown. Gray, very firm, limy clay underlies the subsoil at a depth of about 30 inches.

Fertility is medium, and the available water capacity is medium. Runoff is slow to very slow, and water ponds in depressions, particularly during spring. Permeability is moderately rapid in the sandy loam layers but slow in the underlying clay. The water table is at or near the surface unless lowered by artificial drainage. The gray colors of the subsoil and the underlying material are the result of prolonged saturation.

Most areas of the Munuscong soils in this county are in native grass or brush. Corn and forage are grown in areas artificially drained.

Typical profile of Munuscong sandy loam:

A1—0 to 6 inches, black (10YR 2/1) sandy loam; moderate, fine, granular structure; very friable; contains considerable organic material; slightly acid; clear, irregular boundary.

B21g—6 to 9 inches, grayish-brown (10YR 5/2) sandy loam; weak, medium, granular structure; very friable; slightly acid; gradual, wavy boundary.

B22g—9 to 16 inches, grayish-brown (2.5Y 5/2) sandy loam; few, medium, distinct, yellowish-brown (10YR 5/4) mottles; weak, coarse, granular structure; very friable; neutral; gradual, wavy boundary.

B23g—16 to 24 inches, light-gray (5Y 6/1) heavy sandy loam; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; very weak, medium, subangular blocky structure; friable; mildly alkaline; diffuse, wavy boundary.

B24g—24 to 30 inches, light brownish-gray (10YR 6/2) sandy loam; few, fine, distinct, yellowish-brown (10YR 5/6) mottles; weak, coarse, subangular blocky structure; very friable; mildly alkaline; abrupt, wavy boundary.

IICg—30 to 42 inches +, gray (N 5/0) clay; moderate, medium, angular blocky structure; very firm; calcareous.

The color of the A1 horizon in some areas is very dark brown, and the thickness of this horizon ranges from 5 to 8 inches. In a few areas the B horizon is fine sandy loam or loam and contains thin layers of heavy loamy sand. The reaction of the A and B horizons ranges from slightly acid to mildly alkaline.

Munuscong soils have finer textured upper layers than Pinconning soils and coarser textured upper layers than Paulding soils. They have finer textured underlying material than Breckenridge soils.

Munuscong sandy loam (0 to 1 percent slopes) (Mv).—This soil is on lake plains. A few areas in depressions have a thin layer of muck at the surface.

Excessive wetness hinders tillage of this soil and restricts the growth of roots. Most of the acreage can be drained by tile and open ditches. Shallow surface drains are needed to remove ponded water from depressions. Frost damages crops in low areas in some years.

Most of this soil is in native grass or in brush. Corn and forage crops are grown in drained areas. (Capability unit IIw–8 (3/1c); woodland suitability group W)

Mussey Series

The Mussey series is made up of poorly drained, level or depressional soils on outwash plains and lake plains. These soils formed in loamy material underlain at a depth of 10 to 24 inches with strata of coarse sand and gravel.

In a typical profile, the surface layer is very dark brown sandy loam about 9 inches thick. The subsoil is about 9 inches thick. The upper 3 inches is dark-gray, friable loam mottled with dark yellowish brown and yellowish brown, and the lower 6 inches is grayish-brown, firm gravelly clay loam mottled with dark yellowish brown and yellowish brown. The underlying material, at a depth of about 18 inches, is grayish-brown, loose, limy, stratified gravel and coarse sand mottled with faint brown and light gray.

Fertility is medium, and the available water capacity is medium. Runoff is slow to very slow. The water table is usually within 12 inches of the surface in spring and during wet weather in other seasons. Permeability is moderate, except when the water table is high. The grayish colors result from prolonged saturation. If the water table is lowered by artificial drainage, these shallow, sandy soils tend to be droughty.

The largest areas of these soils are farmed. The selection of crops depends on the effectiveness of artificial drainage. Corn, small grain, and hay are grown in areas that are adequately drained.

Typical profile of Mussey sandy loam:

Ap—0 to 9 inches, very dark brown (10YR 2/2) sandy loam; moderate, fine, granular structure; friable; high in content of organic matter; neutral; abrupt, smooth boundary.

B21g—9 to 12 inches, dark-gray (10YR 4/1) loam; few, fine, distinct, dark yellowish-brown (10YR 4/4) and yellowish-brown (10YR 5/6) mottles; weak, medium, granular structure; friable; neutral; very dark brown coatings on peds; clear, wavy boundary.

B22tg—12 to 18 inches, grayish-brown (10YR 5/2) gravelly clay loam; common, medium, distinct, dark yellowish-brown (10YR 4/4) and yellowish-brown (10YR 5/6) mottles; moderate, medium, subangular blocky structure; slightly plastic when wet, firm when moist; few thin clay films; neutral; abrupt, irregular boundary.

IIC—18 to 42 inches +, grayish-brown (10YR 5/2) stratified gravel and coarse sand; many, medium, faint, brown (10YR 5/3) and light-gray (10YR 6/1) mottles; single grain; loose; calcareous.

In undisturbed areas there is a black A horizon 8 to 13 inches thick. The color of the Ap horizon is black in places, and the thickness of that horizon ranges from 7 to 10 inches. In some areas the B horizon contains fine gravel. The texture of the upper part of the B horizon ranges to heavy sandy loam, light clay loam, and gravelly loam, and that of the lower part to heavy gravelly sandy clay loam. The reaction of the A and B horizons ranges from slightly acid to neutral.

Mussey soils are shallower to sand and gravel than Gilford soils. They formed in material similar to that in which Fabius soils formed but are more poorly drained and grayer than Fabius soils.

Mussey-Gilford sandy loams (0 to 1 percent slopes) (Mw).—This complex occurs on lake plains and outwash plains throughout the county. The plow layer is very dark brown or black.

Each area of this mapping unit is made up partly of Mussey sandy loam and partly of Gilford sandy loam. The proportion of each soil varies between 30 and 70 percent, and there is no definite pattern of occurrence. The two soils are similar in texture and in drainage characteristics, and both are underlain with stratified sand and gravel, but in Mussey sandy loam the depth to the underlying material is less than 24 inches and in Gilford sandy loam it is 24 to 42 inches. Included in mapping were areas of Tawas soils in wet depressions.

Excessive wetness is the main limitation for farming. Artificial drainage by means of tile, open ditches, and surface drains is needed to make the soils suitable for crops. Because ditches and trenches cave in readily, it is advisable to install drainage facilities during periods of dry weather. Straw and other special blinding material are needed to keep soil material from flowing into and plugging tile.

Most areas of these soils are used for forage crops and pasture. (Capability unit IIIw–6 (4c); woodland suitability group W)

Nappanee Series

The Nappanee series is made up of somewhat poorly drained, level to undulating soils on till plains. These soils formed in clayey material.

In a typical profile, the surface layer is dark grayish-brown loam about 8 inches thick. The subsoil is about 20 inches thick. It consists of pale-brown and grayish-brown, very firm clay mottled with gray, strong brown, yellowish brown, and light olive brown. The underlying material, at a depth of about 28 inches, is grayish-brown, very firm, limy clay mottled with light olive brown.

Fertility is moderately high, and the available water capacity is high. Runoff is very slow to moderately slow, depending on the slope. Water ponds in depressions and level areas. Permeability is very slow. The water table is seasonally high. The mottling in the profile is a result of prolonged saturation.

Most areas of Nappanee soils have been drained and are cultivated. Corn and forage crops are the common crops.

Typical profile of a Nappanee loam:

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) loam; moderate, medium, granular structure; friable; medium acid; abrupt, smooth boundary.

B21—8 to 14 inches, pale-brown (10YR 6/3) clay; many, fine, faint, gray (10YR 6/1) and many, fine, distinct, strong-brown (7.5YR 5/6) mottles; moderate, medium, angular blocky structure; very firm; medium acid; diffuse, wavy boundary.

B22tg—14 to 20 inches, grayish-brown (2.5Y 5/2) clay; many, fine, faint, gray (10YR 5/1) and many, medium, distinct, yellowish-brown (10YR 5/6) mottles; moderate, coarse, angular blocky structure; very firm;

thin to thick clay films on ped faces; neutral; gradual, wavy boundary.

B23tg—20 to 28 inches, grayish-brown (2.5Y 5/2) clay; many, fine, distinct, yellowish-brown (10YR 5/4) and light olive-brown (2.5Y 5/4) mottles; moderate, medium, angular blocky structure; very firm; thin clay films on ped faces; mildly alkaline; abrupt, wavy boundary.

Cg—28 to 42 inches +, grayish-brown (2.5Y 5/2) clay; common, medium, faint, light olive-brown (2.5Y 5/4) mottles; weak, medium, angular blocky structure; very firm; calcareous.

In undisturbed areas there is a very dark gray or very dark grayish-brown A1 horizon 2 to 4 inches thick and a grayish-brown or light brownish-gray A2 horizon 3 to 5 inches thick. The color of the Ap horizon is grayish brown in some areas, and the thickness of this horizon ranges from 6 to 9 inches. The texture of the B horizon ranges to silty clay. The thickness of the A and B horizons combined is dominantly between 24 and 36 inches but ranges from 18 to about 42 inches. The reaction of the A and B horizons ranges from medium acid to neutral.

Nappanee soils are better drained and less gray than Hoytville soils. The clay content of Nappanee soils is less than that of Roselms soils and more than that of Del Rey soils.

Nappanee loam, 0 to 2 percent slopes (NaA).—This soil occurs on till plains throughout the county. In some areas the plow layer contains a little pale-brown clay plowed up from the subsoil, and in some areas it is silt loam rather than loam. Included in mapping were small areas of Hoytville soils in drainageways and other low spots. Hoytville soils are slower to dry out than Nappanee soils. Also included were small areas of gently sloping Nappanee soils.

Excessive wetness, the main limitation for farming, delays planting in spring and sometimes delays or prevents harvesting of crops in fall. Farm machinery bogs down readily when the soil is wet. Most of the acreage can be drained by tile and open ditches, but surface drains are needed to remove ponded water from low areas.

Corn and forage crops are the important crops. (Capability unit IIIw–2 (1b); woodland suitability group Z)

Nappanee loam, 2 to 6 percent slopes (NaB).—This soil occurs on till plains throughout the county. It has medium-length, generally undulating slopes. In some areas the plow layer contains a little pale-brown clay plowed up from the subsoil, and in some areas this layer is silt loam rather than loam. Included in mapping were areas of Hoytville soils in narrow drainageways. Hoytville soils are slower to dry out than Nappanee soils. Also included were small areas of level Nappanee soils and of moderately eroded, gently sloping Nappanee soils.

Excessive wetness, the main limitation for farming, delays planting in spring and sometimes delays or prevents harvesting of crops in fall. Farm machinery bogs down readily when the soil is wet. Installing a complete drainage system is difficult where the relief is undulating, but random tile and surface drains are effective in such areas. An erosion hazard is another limitation.

Corn and forage crops are the common crops. (Capability unit IIIw–2 (1b); woodland suitability group Z)

Nappanee silty clay loam, 0 to 2 percent slopes (NpA).—This soil occurs as small areas on till plains throughout the county. It is less friable and less easy to work than the Nappanee loams. In many areas pale-brown clay plowed up from the subsoil is scattered through the plow layer. Included in mapping were areas of Hoytville soils in drainageways and other low areas. Hoytville soils are slower to dry out than Nappanee soils.

Excessive wetness and poor tilth are the main limitations for farming. Tile and open ditches are needed, and also surface drains for removal of ponded water from depressions.

Corn and forage crops are the common crops. (Capability unit IIIw–2 (1b); woodland suitability group Z)

Nappanee silty clay loam, 2 to 6 percent slopes, moderately eroded (NpB2).—This soil occurs as small areas next to natural drainageways on till plains throughout the county. It has short slopes, generally of more than 4 percent. It is less friable and less easy to work than the Nappanee loams. Erosion has removed more than half the original surface layer. The present plow layer is grayish brown in color and contains considerable amounts of pale-brown clay plowed up from the subsoil. Included in mapping were spots of severely eroded Nappanee soils, in which the clay subsoil is exposed.

Excessive wetness, poor tilth, and a hazard of further erosion are the main limitations for farming. The soil puddles if worked when too wet. Installing a complete drainage system is difficult where the relief is undulating, but random tile and surface drains are effective in such areas.

Corn and forage crops are the common crops. (Capability unit IIIw–2 (1b); woodland suitability group Z)

Oshtemo Series

The Oshtemo series is made up of well-drained, level to sloping soils on outwash plains and moraines. These soils formed in sandy loam or loamy sand underlain at a depth of 42 to about 66 inches with strata of limy sand and gravel (fig. 13).

In a typical profile, the surface layer is brown sandy loam about 8 inches thick. The subsurface layer, about 12 inches thick, is yellowish-brown, very friable loamy sand. The subsoil is about 32 inches thick. It consists of a 7-inch layer of yellowish-red, friable heavy sandy loam, a 9-inch layer of strong-brown, very friable light sandy loam, and a 16-inch layer of light yellowish-brown, loose light loamy sand. The underlying material, at a depth of about 52 inches, is light-gray, loose, limy, stratified sand and fine gravel.

Fertility is low. The available water capacity is moderately low; the moisture supply is rarely adequate for optimum growth of crops. Permeability is moderately rapid. The soils dry out quickly in spring and are easy to work.

Some areas of these soils are farmed, some are idle, and some are in woods. Corn, small grain, and hay are the major crops. Deep-rooted forage crops and other crops that resist drought and mature early are to be preferred.

Typical profile of an Oshtemo sandy loam:

Ap—0 to 8 inches, brown (10YR 4/3) sandy loam; weak, fine, granular structure; very friable; medium acid; abrupt, wavy boundary.

A2—8 to 20 inches, yellowish-brown (10YR 5/6) loamy sand; weak, fine, granular structure; very friable; strongly acid; clear, wavy boundary.

B21t—20 to 27 inches, yellowish-red (5YR 4/6) heavy sandy loam; weak, fine, subangular blocky structure; friable; strongly acid; gradual, irregular boundary.

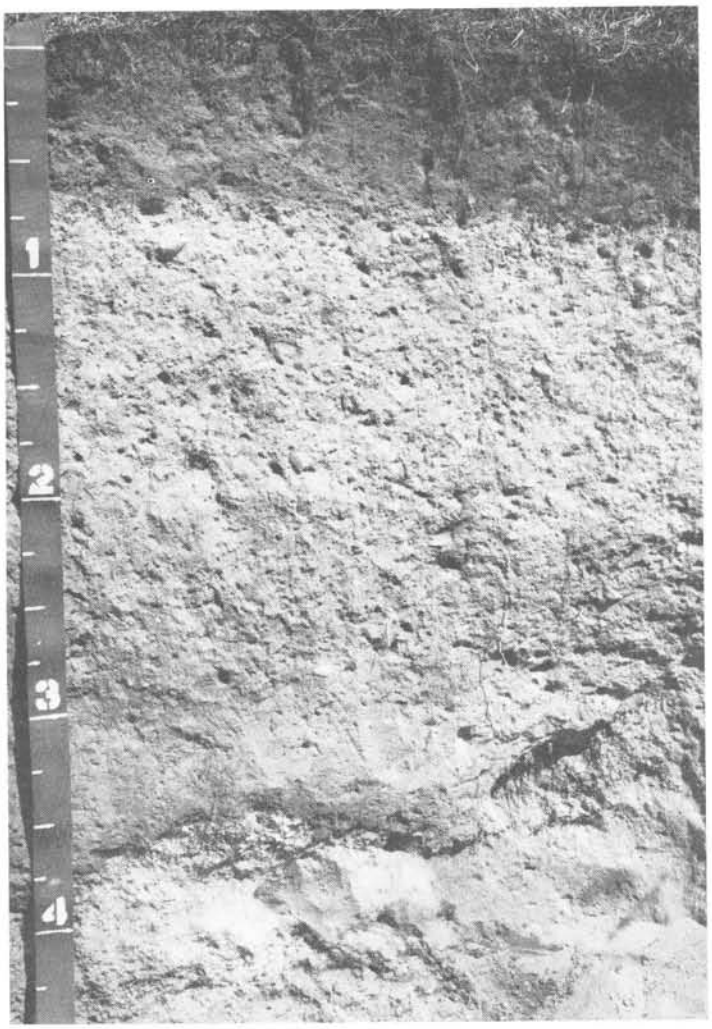

Figure 13.—**Profile of an Oshtemo sandy loam. This is a well-drained soil underlain at a depth of about 42 inches or more with stratified sand and gravel. Numbers on tape indicate depth in feet.**

B22t—27 to 36 inches, strong-brown (7.5YR 5/8) light sandy loam; weak, coarse, subangular blocky structure; very friable; medium acid; diffuse, wavy boundary.

B3—36 to 52 inches, light yellowish-brown (10YR 6/4) light loamy sand; single grain; loose; medium acid; abrupt, smooth boundary.

IIC—52 to 72 inches +, light-gray (10YR 7/2) stratified sand and fine gravel; single grain; loose; calcareous.

In undisturbed areas there is a very dark grayish-brown A horizon 2 to 4 inches thick. The color of the Ap horizon is dark grayish brown in some areas, and the thickness of that horizon ranges from 7 to 10 inches. In a few areas the texture of the B horizon is light sandy clay loam. The depth to the IIC horizon is predominantly between 45 and 60 inches but ranges from 42 to about 66 inches. The reaction of the A and B horizons ranges from strongly acid to medium acid.

Oshtemo soils have a thicker subsoil than Boyer and Spinks soils. They are better drained than Brady soils and lack the mottles that are characteristic of Brady soils.

Oshtemo sandy loam, 0 to 2 percent slopes (OsA).—This soil is on outwash plains in the central and southern parts of the county.

A shortage of available water during the growing season slows the growth of crops. Water erosion is not a significant hazard, but soil blowing can cause damage if large areas are left bare of vegetation.

Most of this soil is farmed intensively. Corn, small grain, and forage crops (fig. 14) are the common crops. (Capability unit IIIs–3 (4a); woodland suitability group M)

Oshtemo sandy loam, 2 to 6 percent slopes (OsB).—This soil is on outwash plains and low moraines in the central and southern parts of the county. Included in the areas mapped were small areas of level Oshtemo soils and, on unprotected crests of slopes, small areas of moderately eroded Oshtemo soils.

A shortage of available water during the growing season slows the growth of crops.

Most of this soil is farmed intensively. Corn, small grain, and forage crops are the common crops. (Capability unit IIIs–4 (4a); woodland suitability group M)

Oshtemo sandy loam, 6 to 12 percent slopes (OsC).—This soil occurs as small areas on moraines in the central and southern parts of the county. It has short to medium, uniform to irregular slopes. In some wooded areas the uppermost 2 to 4 inches of the surface layer is high in organic-matter content and is dark grayish brown in color. Small areas in cultivated fields are moderately eroded.

The use of this soil for farming is limited by a severe hazard of erosion and a shortage of available water during much of the growing season.

Most of the acreage is in woods. (Capability unit IIIe–9 (4a); woodland suitability group M)

Owosso Series

The Owosso series is made up of well drained to moderately well drained, level to sloping soils on till plains and moraines. These soils formed in sandy loam underlain at a depth of 18 to 42 inches with glacial till of loam or clay texture.

In a typical profile, the surface layer is dark grayish-brown sandy loam about 10 inches thick. The subsurface layer, about 9 inches thick, is yellowish-brown, very friable light sandy loam. The subsoil is about 12 inches thick. The upper 6 inches is brown, very friable sandy loam, and the lower 6 inches is brown, firm clay loam. The underlying material, at a depth of about 31 inches, is pale-brown, friable, limy loam.

Fertility is moderate. The available water capacity is moderate; although the moisture supply is generally adequate for crops, shortages occur during periods of dry weather. Runoff is slow to medium, depending on the slope and the nature of the vegetation. Permeability is moderately rapid in the upper layers and moderately slow in the lower layers. These soils dry out and are ready for tillage early in spring.

Most areas of Owosso soils are farmed intensively. A few areas are used as pasture or have remained in woods.

Typical profile of an Owosso sandy loam:

Ap—0 to 10 inches, dark grayish-brown (10YR 4/2) sandy loam; weak, fine, granular structure; very friable; slightly acid; clear, smooth boundary.

A2—10 to 19 inches, yellowish-brown (10YR 5/4) light sandy loam; weak, fine, granular structure; very friable; medium acid; clear, wavy boundary.

Figure 14.—Oshtemo sandy loam, 0 to 2 percent slopes. This area produces forage for livestock.

B1—19 to 25 inches, brown (10YR 4/3) sandy loam; weak, fine, subangular blocky structure; very friable; slightly acid; clear, wavy boundary.
IIB2t—25 to 31 inches, brown (10YR 4/3) clay loam; strong, fine, subangular blocky structure; firm; thin reddish-brown (5YR 4/3) clay films on ped surfaces; neutral; abrupt, wavy boundary.
IIC—31 to 42 inches +, pale-brown (10YR 6/3) loam; weak, medium, platy structure; friable; calcareous.

In undisturbed areas there is a very dark gray A1 horizon 2 to 4 inches thick. The thickness of the IIB2t horizon ranges from 4 to 15 inches. In a few areas the texture of the IIC horizon is light clay loam. The reaction of the A and B horizons ranges from medium acid to neutral.

Owosso soils formed in material similar to that in which Metamora soils formed, but Owosso soils are better drained than Metamora soils and lack mottles. Owosso soils are finer textured in the upper part of the B horizon than Menominee soils and coarser textured than Miami soils.

Owosso sandy loam, 0 to 2 percent slopes (OwA).—This soil is on till plains. In places the plow layer contains fine gravel. Included in mapping were a few small areas of gently sloping Owosso soils next to drainageways.

Permeability is moderately rapid in the upper layers of this soil, and the available water capacity is only moderate. The growth of crops is slowed by a shortage of available water. Runoff is slow, and the hazard of water erosion is not significant. Soil blowing can cause damage if large areas are left bare of vegetation.

Small grain, corn, and alfalfa are the common crops. (Capability unit IIs–2 (3/2a); woodland suitability group U)

Owosso sandy loam, 2 to 6 percent slopes (OwB).—This soil is on till plains and moraines. On the uplands, the slopes are short to medium. On the till plains, the slopes are long and uniform and the landscape is gently undulating. Included in mapping were small areas of level Owosso soils on the till plains.

The hazard of erosion in unprotected areas is a moderate limitation for farming. Permeability is moderately rapid in the upper layers. The available water capacity is only moderate; consequently, crops do not get enough water in some years.

Most of this soil is cultivated. Small grain, corn, and alfalfa are common crops. (Capability unit IIe–3 (3/2a); woodland suitability group U)

Owosso sandy loam, 6 to 12 percent slopes (OwC).—This soil is on moraines. The slopes are short to medium in length and in many areas are irregular in shape. In places the plow layer contains a little yellowish-brown material plowed up from the subsurface layer. Included in mapping were small areas of less sloping and of steeper Owosso soils.

The hazard of erosion in unprotected areas is a severe limitation for farming. Contour tillage and contour stripcropping, which help to control erosion, are impractical where the slopes are irregular. Permeability is moderately rapid in the upper layers, and the available water capacity is moderately low; consequently, crops do not get enough moisture in some years.

Most of this soil is cultivated. Small grain, corn, and alfalfa are the common crops. (Capability unit IIIe–6 (3/2a); woodland suitability group U)

Owosso sandy loam, 6 to 12 percent slopes, moderately eroded (OwC2).—This soil occurs as small areas on moraines. It has short, irregular slopes. Erosion has removed between a third and a half of the original surface layer, and the part that remains has been mixed with the upper part of the subsurface layer. The present plow layer is brown. It is less fertile than the plow layer of uneroded Owosso soils, contains less organic matter, and has less available water capacity. Included in mapping were small areas of less sloping and of steeper Owosso soils.

The effects of erosion and the hazard of further erosion are severe limitations for farming. Contour tillage and contour stripcropping, which help to control erosion, are not practical where the slopes are short and irregular. The supply of water available to crops is limited during periods of dry weather.

All of this soil is cultivated or has been intensively cultivated in the past. Small grain, corn, and forage crops are the common crops. (Capability unit IIIe–6 (3/2a); woodland suitability group U)

Paulding Series

The Paulding series is made up of poorly drained to very poorly drained, level or depressional soils on lake plains. These soils formed in clayey material. They are the finest textured soils in the county.

In a typical profile, the surface layer is dark-gray clay about 8 inches thick. The subsoil is about 26 inches thick. The upper 15 inches is gray, very firm clay mottled with strong brown and yellowish red. The lower 11 inches is olive-gray, very firm clay mottled with yellowish brown. The underlying material, at a depth of 34 inches, is gray, very firm, limy clay mottled with yellowish brown and light olive brown.

Fertility is moderately high, and the available water capacity is moderately high. Permeability is very slow. Runoff is slow to very slow, and water ponds in depressions. The water table is near the surface; unless lowered by artificial drainage, it restricts the growth of roots and prevents early cultivation. The gray color is a result of prolonged saturation. Because of the clay texture and the high water table, these soils are slow to dry out and warm up. They puddle if farmed when wet, then dry out hard and cloddy and with impaired tilth.

About a third of the acreage is still in woods. Of the rest, part is now cultivated, part is used for native pasture, and part is idle.

Typical profile of Paulding clay:

Ap—0 to 8 inches, dark-gray (5Y 4/1) clay; weak, medium, subangular blocky structure; very sticky, firm; slightly acid; abrupt, smooth boundary.

B21g—8 to 13 inches, gray (5Y 5/1) clay; common, fine, prominent, strong-brown (7.5YR 5/6) and yellowish-red (5YR 4/6) mottles; weak, coarse, prismatic structure breaking to weak, very coarse, angular blocky; plastic, very firm; slightly acid; clear, wavy boundary.

B22g—13 to 23 inches, gray (5Y 5/1) clay; many, medium, prominent, strong-brown (7.5YR 5/6) mottles; weak, coarse, prismatic structure breaking to weak, coarse, angular blocky; plastic, very firm; neutral; gradual, irregular boundary.

B23g—23 to 34 inches, olive-gray (5Y 5/2) clay; many, medium, prominent, yellowish-brown (10YR 5/4) mottles; very weak, coarse, angular blocky structure; plastic, very firm; mildly alkaline; abrupt, wavy boundary.

Cg—34 to 42 inches +, gray (5Y 5/1) clay; many, medium, prominent, yellowish-brown (10YR 5/4) and light olive-brown (2.5Y 5/4) mottles; massive; plastic, very firm; contains fine lenses of white calcareous material; calcareous.

The color of the Ap horizon in some areas is dark grayish brown. The thickness of the A and B horizons combined ranges from about 20 to 42 inches. The reaction of the A and B horizons ranges from medium acid to mildly alkaline.

Paulding soils are more poorly drained and grayer then Roselms soils. They contain a higher percentage of clay than Hoytville soils.

Paulding clay (0 to 1 percent slopes) (Pa).—This soil occurs as large areas on lake plains in the northern part of the county. Included in mapping were small areas of Willette muck in depressions.

Excessive wetness and poor tilth are the main limitations for farming. Tile, open ditches, and surface drains are needed to lower the water table and drain low spots. Drainage is difficult, partly because the permeability is very slow and partly because many areas lack outlets. Farm machinery bogs down readily when the soil is wet.

Corn and forage crops are the crops commonly grown in the cultivated areas. (Capability unit IIIw–1 (0c); woodland suitability group P)

Pewamo Series

The Pewamo series is made up of poorly drained, level or depressional soils on till plains. These soils formed in glacial till of clay loam or silty clay loam texture.

In a typical profile, the surface layer is very dark brown loam about 9 inches thick. The subsurface layer, about 2 inches thick, is very dark gray, friable loam. The subsoil is about 23 inches thick. It consists of a 2-inch layer of dark-gray, firm heavy clay loam mottled with dark yellowish brown, a 13-inch layer of gray, very firm light clay mottled with yellowish brown, and an 8-inch layer of gray, firm heavy clay loam mottled with yellowish brown. The underlying material, at a depth of 34 inches, is grayish-brown, firm, limy clay loam mottled with light gray.

Fertility is moderately high. Permeability is moderately slow, and the available water capacity is high. Runoff is very slow to ponded. The gray color of the subsoil results from prolonged saturation. The soils puddle if tilled when wet, then dry out hard and cloddy and with impaired tilth.

These soils are suitable for crops if artificially drained. Most areas are cultivated or used for pasture. The undrained areas are in woods or are idle and growing up to brush.

Typical profile of Pewamo loam:

Ap—0 to 9 inches, very dark brown (10YR 2/2) loam; strong, coarse, granular structure; friable; slightly acid; abrupt, smooth boundary.

A1—9 to 11 inches, very dark gray (10YR 3/1) loam; moderate, coarse, granular structure; friable; slightly acid; gradual, wavy boundary.

B21tg—11 to 13 inches, dark-gray (10YR 4/1) heavy clay loam; few, medium, distinct, dark yellowish-brown

(10YR 4/4) mottles; strong, medium, angular blocky structure; firm; slightly acid; gradual, wavy boundary.

B22tg—13 to 26 inches, gray (5YR 5/1) light clay; common, medium, distinct, yellowish-brown (10YR 5/8) mottles; strong, medium, angular blocky structure; very firm; neutral; gradual, irregular boundary.

B23tg—26 to 34 inches, gray (10YR 5/1) heavy clay loam; many, medium, distinct, yellowish-brown (10YR 5/4) mottles; moderate, coarse, angular blocky structure; firm; mildly alkaline; abrupt, wavy boundary.

Cg—34 to 48 inches +, grayish-brown (10YR 5/2) clay loam; common, medium, faint, light-gray (10YR 6/1) mottles; weak, coarse, angular blocky structure; firm; calcareous.

In areas not yet farmed, there is a black or very dark brown A1 horizon 9 to 14 inches thick. The texture of the B horizon ranges from heavy clay loam or heavy silty clay loam to light clay. The thickness of the A and B horizons combined ranges from 24 to about 42 inches. In a few areas the texture of the C horizon is silty clay loam. The reaction of the A and B horizons ranges from slightly acid to mildly alkaline.

Pewamo soils have coarser textured underlying material than Hoytville soils and finer textured underlying material than Brookston soils. They formed in material similar to that in which Blount soils formed but are darker colored and more poorly drained than Blount soils.

Pewamo loam (0 to 1 percent slopes) (Pe).—This soil is on till plains throughout the county. The plow layer is very dark brown. Included in mapping were small areas of Willette muck in depressions.

Excessive wetness, the main limitation for farming, causes delays in planting and tillage in wet years, unless corrected by artificial drainage.

Large tracts of this soil in the eastern part of the county are farmed intensively. Corn, sugar beets, and forage crops are grown. Smaller areas have remained in woods. (Capability unit IIw–2 (1.5c); woodland suitability group P)

Pewamo clay loam (0 to 1 percent slopes) (Pm).—This soil occurs as small areas on till plains throughout the county. The plow layer is very dark brown.

Excessive wetness and poor tilth are the main limitations for farming. Artificial drainage is needed to make tillage and the production of crops practical. This soil has more tendency to puddle and clod than Pewamo loam.

If drained and kept in good tilth, this soil is suited to corn and forage crops. (Capability unit IIw–2 (1.5c); woodland suitability group P)

Pinconning Series

The Pinconning series is made up of poorly drained, level or depressional soils on lake plains. These soils formed in loamy sand and sand underlain at a depth of 18 to 42 inches with silty clay and clay.

In a typical profile, the surface layer is very dark brown loamy sand about 7 inches thick. Below the surface layer is dark grayish-brown to grayish-brown, very friable loamy sand about 15 inches thick. Below this is a 12-inch layer of light-gray, loose sand mottled with yellowish brown. At a depth of about 34 inches is gray, very firm, limy clay mottled with olive brown and light olive brown.

Fertility is low. Permeability is moderately rapid in the upper layers but very slow in the underlying clay. The available water capacity is moderately low. Runoff is very slow to ponded. The water table is at or near the surface unless lowered by artificial drainage. After drainage, these soils tend to be droughty.

A few areas of these soils have been drained and are used for crops and pasture. Most areas are not drained and are still in woods.

Typical profile of Pinconning loamy sand:

A1—0 to 7 inches, very dark brown (10YR 2/2) loamy sand; moderate, fine, granular structure; very friable; contains considerable organic material; slightly acid; abrupt, wavy boundary.

C1g—7 to 12 inches, dark grayish-brown (10YR 4/2) loamy sand; weak, fine, granular structure; very friable; neutral; gradual, wavy boundary.

C2g—12 to 22 inches, grayish-brown (2.5Y 5/2) loamy sand; weak, coarse, granular structure; very friable; mildly alkaline; gradual, wavy boundary.

C3g—22 to 34 inches, light-gray (5Y 6/1) sand; common, medium, distinct, yellowish-brown (10YR 5/4) mottles; single grain; loose; mildly alkaline; clear, wavy boundary.

IIC4g—34 to 60 inches +, gray (5Y 6/1) clay; many, coarse, distinct, olive-brown (2.5Y 4/4) and light olive-brown (2.5Y 5/6) mottles; massive; very firm; scattered thin seams and lenses of coarse sand and fine gravel; calcareous.

The color of the A horizon ranges from black to very dark grayish brown. A layer of muck less than 12 inches thick is at the surface in a few areas. The reaction of the A horizon and the upper part of the C horizon ranges from slightly acid to mildly alkaline.

Pinconning soils have coarser textured upper layers than Munuscong soils and finer textured underlying material than Brevort soils.

Pinconning loamy sand (0 to 1 percent slopes) (Pn).—This soil occurs as small areas on lake plains in the central and northern parts of the county. It is characterized by small wet depressions and areas that have a thin layer of muck at the surface.

Excessive wetness and low fertility are the main limitations for farming. Drainage is likely to be difficult, partly because of the level relief and partly because of the unstable nature of the soil material. Areas that are drained effectively tend to be droughty.

Native grass and scattered stands of aspen cover most of this soil. (Capability unit IIIw–7 (4/1c); woodland suitability group W)

Richter Series

The Richter series is made up of somewhat poorly drained, level to undulating soils on outwash plains. These soils formed in strata of water-deposited fine sandy loam, sandy loam, and loamy sand.

In a typical profile, the surface layer is very dark gray sandy loam about 10 inches thick. The subsurface layer, about 2 inches thick, is gray, very friable sandy loam. The subsoil is about 20 inches thick. The upper 7 inches is yellowish-brown, very friable fine sandy loam mottled with light brownish gray. The lower 13 inches is light brownish-gray, friable heavy sandy loam mottled with yellowish brown and stratified with thin layers of silt. The underlying material, at a depth of about 32 inches, consists of strata of light brownish-gray, friable, limy sandy loam, fine sandy loam, and loamy sand mottled with yellowish brown and containing thin layers of fine gravel.

Fertility is moderate. Permeability is moderate, and the available water capacity is moderate; the moisture

supply is generally adequate for optimum growth of crops. Runoff is slow, and water ponds in depressions. The water table is high in spring and after rain in other seasons.

If artificially drained, these soils are easy to work and to keep in good tilth and can be used for most of the common crops.

Typical profile of a Richter sandy loam:

Ap—0 to 10 inches, very dark gray (10YR 3/1) sandy loam; weak, fine, granular structure; very friable; high organic-matter content; mildly alkaline; abrupt, smooth boundary.

A2—10 to 12 inches, gray (10YR 5/1) sandy loam; weak, medium, granular structure; very friable; mildly alkaline; abrupt, smooth boundary.

Bir—12 to 19 inches, yellowish-brown (10YR 5/6) fine sandy loam; common, medium, distinct, light brownish-gray (10YR 6/2) mottles; weak, medium, platy structure; very friable; mildly alkaline; gradual, wavy boundary.

B'tg—19 to 32 inches, light brownish-gray (10YR 6/2) heavy sandy loam; thin layers of silt; many, coarse, distinct, yellowish-brown (10YR 5/6) mottles; weak, medium, subangular blocky structure; friable; mildly alkaline; abrupt, wavy boundary.

IIC—32 to 42 inches +, light brownish-gray (10YR 6/2) stratified sandy loam, fine sandy loam, and loamy sand and thin layers of fine gravel; many, coarse, distinct, yellowish-brown (10YR 5/8) mottles; weak, medium, platy structure; friable; calcareous.

In undisturbed areas, there is a very dark gray A1 horizon 2 to 4 inches thick. The color of the Ap horizon ranges to very dark grayish brown, and the thickness of that horizon ranges from 7 to 11 inches. The texture of the B'tg horizon is loam or heavy fine sandy loam in a few areas. The reaction of the A and B horizons ranges from slightly acid to mildly alkaline.

Richter soils have a coarser textured profile than Kibbie soils and a finer textured subsoil than Tedrow soils. They are better drained than Tonkey soils.

Richter sandy loam, 0 to 2 percent slopes (RcA).—This soil is on outwash plains in the central and northern parts of the county. Included in mapping were small areas of Tonkey soils in depressions and narrow drainageways. These included areas dry out more slowly than the surrounding Richter soil.

Excessive wetness early in spring is the main limitation for farming. Farm machinery bogs down when the soil is wet, and farming operations are delayed unless excess water is removed by means of tile and ditches.

If drainage is effective and the supply of available water adequate, this soil is suited to corn, small grain, and forage crops. Most of the acreage is cultivated. (Capability unit IIw–6 (3b); woodland suitability group G)

Richter sandy loam, 2 to 6 percent slopes (RcB).—This soil is on outwash plains in the central and northern parts of the county. It has uniform, short to medium-length slopes. In some areas the plow layer contains a little yellowish-brown fine sandy loam plowed up from the subsoil.

Excessive wetness early in spring is a limitation of most areas of this soil. Installing a complete drainage system is difficult where the relief is undulating.

If drainage is effective and the supply of available water adequate, this soil is suited to corn, small grain, and forage crops. (Capability unit IIw–7 (3b); woodland suitability group G)

Roselms Series

The Roselms series is made up of somewhat poorly drained, level to undulating soils on lake plains. These soils formed in glacial material of clayey texture.

In a typical profile, the surface layer is dark grayish-brown clay loam about 7 inches thick. The subsoil is about 16 inches thick. The upper 10 inches is grayish-brown, very firm clay mottled with dark brown, and the lower 6 inches is light olive-brown, extremely firm clay mottled with gray. The underlying material, at a depth of 23 inches, is light olive-brown, extremely firm, limy clay mottled with gray.

Fertility is moderately high. Permeability is very slow, and the available water capacity is moderately high. Runoff is slow to rapid, depending on the slope and the effects of erosion. The water table is high during periods of wet weather. The mottling is the result of prolonged saturation. This soils puddle if worked when wet, then dry out hard and cloddy and in poor tilth.

Corn and forage crops are grown in drained areas of these soils. Some areas are in native pasture, and some are idle.

Typical profile of a Roselms clay loam:

Ap—0 to 7 inches, dark grayish-brown (2.5Y 4/2) clay loam; weak, medium, granular structure; firm; slightly acid; abrupt, smooth boundary.

B21tg—7 to 17 inches, grayish-brown (10YR 5/2) clay; common, medium, distinct, dark-brown (10YR 4/3) mottles; moderate, medium, prismatic structure breaking to moderate, medium, angular blocky; very firm; slightly acid; gradual, wavy boundary.

B22t—17 to 23 inches, light olive-brown (2.5Y 5/4) clay; many, medium, distinct, gray (5Y 5/1) mottles; weak, medium, angular blocky structure; extremely firm; mildly alkaline; gradual, wavy boundary.

C—23 to 42 inches +, light olive-brown (2.5Y 5/4) clay; many, medium, distinct, gray (5Y 5/1) mottles; massive; extremely firm; calcareous.

In areas not yet farmed, there is a very dark gray A1 horizon 1 to 3 inches thick. The thickness of the A and B horizons combined ranges from 18 to about 36 inches. The reaction of the A and B horizons ranges from slightly acid to mildly alkaline.

Roselms soils are better drained and less gray than Paulding soils. They contain more clay than Nappanee soils.

Roselms clay loam, 0 to 2 percent slopes (RoA).—This soil occurs as large areas on lake plains in the northern part of the county. In many areas the plow layer contains a little grayish-brown clay plowed up from the subsoil. Included in mapping were small areas of Paulding soils in narrow drainageways and small areas of gently sloping Roselms soils.

Excessive wetness and poor tilth are the main limitations for farming. Tile, open ditches, and surface drains are needed to improve drainage.

Corn and forage crops are the most common crops. (Capability unit IIIw–1 (0c); woodland suitability group Z)

Roselms clay loam, 2 to 6 percent slopes (RoB).—This soil occurs as small areas on lake plains in the northern part of the county. It has uniform, medium-length slopes. In many areas the plow layer contains a little grayish-brown clay plowed up from the subsoil. Included in mapping were small areas of Paulding soils in narrow drainageways and small areas of level Roselms soils.

Excessive wetness and poor tilth are the main limitations for farming. Tile and open ditches are needed to improve drainage. Installing a complete drainage system is difficult in areas where the relief is undulating.

Corn and forage crops are the crops commonly grown. (Capability unit IIIw–1 (0b); woodland suitability group Z)

Roselms clay loam, 2 to 6 percent slopes, moderately eroded (RoB2).—This soil occurs as small areas adjacent to drainageways on lake plains in the northern part of the county. It has short slopes, mainly of 4 to 6 percent. The plow layer is grayish brown. In many areas it contains pieces of grayish-brown clay. Rills are common on the upper part of slopes in cultivated areas. Included in mapping were a few spots of Roselms soils so severely eroded that the subsoil is exposed.

Excessive wetness, poor tilth, and the hazard of further erosion are limitations for farming. Artificial drainage is needed to make the production of crops practical, but undulating relief makes it difficult to install a complete drainage system. Runoff is rapid, and consequently there is some hazard of erosion.

Corn and forage crops are grown. (Capability unit IIIw–1 (0b); woodland suitability group Z)

St. Clair Series

The St. Clair series is made up of moderately well drained, gently sloping to sloping soils on till plains and moraines. These soils formed in clayey material.

In a typical profile, the surface layer is dark grayish-brown silty clay loam about 6 inches thick. The subsurface layer, about 2 inches thick, is grayish-brown, friable silty clay loam. The subsoil is about 16 inches thick and consists mainly of brown, very firm clay mottled with yellowish brown and strong brown. The underlying material, at a depth of about 24 inches, is brown, very firm, limy clay mottled with yellowish brown.

Fertility is moderately high, permeability is very slow, and the available water capacity is high. Runoff is medium to rapid, depending on the slope. These soils dry out slowly in spring and after rain in other seasons. They will not support farm machinery when wet.

Most areas of these soils are used intensively for crops. A few areas are used for pasture, and a few are in woods.

Typical profile of a St. Clair silty clay loam:

Ap—0 to 6 inches, dark grayish-brown (2.5Y 4/2) silty clay loam; weak, medium, granular structure; friable; mildly alkaline; abrupt, smooth boundary.

A2—6 to 8 inches, grayish-brown (2.5Y 5/2) silty clay loam; weak, medium, platy structure; friable; mildly alkaline; abrupt, wavy boundary.

B21t—8 to 14 inches, brown (10YR 5/3) clay; few, medium, distinct, light yellowish-brown (10YR 6/4) and strong-brown (7.5YR 5/6) mottles; moderate, medium, angular blocky structure; very firm; slightly acid; clear, wavy boundary.

B22t—14 to 24 inches, brown (10YR 5/3) (interior of peds) and gray (5Y 6/1) (exterior ped coatings) clay; moderate, medium, angular blocky structure; very firm; mildly alkaline; abrupt, wavy boundary.

C—24 to 42 inches, brown (10YR 5/3) clay; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; thin gray (5Y 6/1) coatings on peds; moderate, medium, angular blocky structure; very firm; calcareous.

In undisturbed areas there is a very dark grayish-brown A1 horizon 1 to 3 inches thick. The texture of the B horizon in some areas is silty clay. The thickness of the A and B horizons combined ranges from 18 to about 36 inches. The reaction of the A and B horizons ranges from medium acid to mildly alkaline.

St. Clair soils are better drained and less mottled than Nappanee soils. They have finer textured underlying material than Morley soils.

St. Clair silty clay loam, 2 to 6 percent slopes, moderately eroded (ScB2).—This soil occurs as a few small areas on till plains in the eastern and northern parts of the county. It has short, uniform slopes. More than half the original surface layer has been lost through erosion. The plow layer is less fertile and contains less organic matter than the original surface layer, and it crusts readily when dry. Included in mapping were spots of severely eroded St. Clair soils; in these spots, germination of seeds is uneven and stands of plants are poor. Also included were small areas of Nappanee soils in drainageways; these inclusions dry out more slowly than the surrounding St. Clair soil.

Runoff is medium, and the hazard of further erosion is severe. Tilth is generally poor.

Corn and forage crops are the important crops. (Capability unit IIIe–3 (1a); woodland suitability group B)

St. Clair silty clay loam, 6 to 12 percent slopes, moderately eroded (ScC2).—This soil is on low moraines in the eastern and northern parts of the county. It has uniform, short to medium-length slopes. Erosion has removed more than half the original surface layer from most of the acreage. The present plow layer is brown. As a result of erosion, it is less fertile, contains less organic matter, and has poorer tilth than the original surface layer. Included in mapping were spots of severely eroded St. Clair soils; in these spots, the surface crusts readily, germination of seeds is uneven, and stands of plants are poor. Also included were a few small areas of Menominee soils on the crests of slopes.

The severe hazard of further erosion is the main limitation for farming. Tilth is poor in most areas.

Small grain, alfalfa, and other forage crops are the important crops. A continuous cover of vegetation would help to check runoff and control erosion. (Capability unit IIIe–4 (1a); woodland suitability group B)

Sebewa Series

The Sebewa series is made up of poorly drained, level or depressional soils on outwash plains and lake plains. These soils formed in loamy material underlain at a depth of 24 to 42 inches with stratified coarse sand and gravel.

In a typical profile, the surface layer is black loam about 10 inches thick. The subsoil is about 24 inches thick. It consists of a 3-inch layer of dark-gray, firm light clay loam mottled with dark yellowish brown; a 5-inch layer of grayish-brown, firm gravelly clay loam mottled with yellowish brown; and a 16-inch layer of grayish-brown, firm gravelly clay loam mottled with yellowish brown.

Fertility is medium. Runoff is slow. The water table is within 12 inches of the surface in spring and during wet weather in other seasons. Permeability is moderate, except when the water table is high. The available water capacity is moderate. The high water table restricts the growth of roots, and prolonged saturation has resulted

in the grayish colors of the soils. If the water table is lowered by artificial drainage, the soils tend to be slightly droughty.

If artificially drained, these soils are used for crops, mainly corn.

Typical profile of Sebewa loam:

Ap—0 to 10 inches, black (10YR 2/1) loam; moderate, fine, granular structure; friable; slightly acid; abrupt, smooth boundary.

B21g—10 to 13 inches, dark-gray (10YR 4/1) light clay loam; few, fine, distinct, dark yellowish-brown (10YR 4/4) mottles; thin, black (10YR 2/1), organic coatings on ped faces; moderate, medium, subangular blocky structure; firm; slightly acid; clear, wavy boundary.

B22tg—13 to 18 inches, grayish-brown (10YR 5/2) gravelly clay loam; common, medium, distinct, yellowish-brown (10YR 5/8) mottles; moderate, coarse, subangular blocky structure; firm; neutral; gradual, wavy boundary.

B23tg—18 to 34 inches, grayish-brown (2.5Y 5/2) gravelly clay loam; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; weak, coarse, subangular blocky structure; firm; neutral; abrupt, wavy boundary.

IIC—34 to 42 inches, grayish-brown (2.5Y 5/2) stratified gravel and coarse sand; common, medium, distinct, yellowish-brown (10YR 5/4) mottles; single grain; loose; calcareous.

In undisturbed areas there is a very dark grayish-brown or black A horizon 8 to 14 inches thick. The color of the Ap horizon in a few areas is very dark brown, and the thickness of that horizon ranges from 7 to 10 inches. The texture of the lower part of the B horizon is gravelly sandy clay loam or gravelly heavy sandy loam in a few areas. The reaction of of the A and B horizons ranges from slightly acid to mildly alkaline.

Sebewa soils have a thicker B horizon and are deeper to sand and gravel than Mussey soils but are in the same drainage class. Sebewa soils are more poorly drained than Matherton soils.

Sebewa loam (0 to 1 percent slopes) (Se).—This soil occurs as small areas on outwash plains and lake plains throughout the county. In some places the surface layer is very dark grayish brown rather than black. In a few areas the surface has been covered with 6 to 10 inches of coarser textured soil material washed from adjacent uplands. In a few depressions a layer of muck less than 10 inches thick is at the surface.

The use of this soil is limited mainly by excessive wetness, partly a result of runoff from adjacent uplands.

If drained, this soil is suited to corn and other crops commonly grown in the county. Many small areas are still in woods. (Capability unit IIw–6 (3c); woodland suitability group W)

Sisson Series

The Sisson series is made up of well-drained, gently sloping to sloping soils on lake plains, outwash plains, and moraines. These soils formed in stratified silt, very fine sand, and fine sand.

In a typical profile, the surface layer is dark-brown very fine sandy loam about 9 inches thick. The subsurface layer, about 3 inches thick, is light yellowish-brown, friable very fine sandy loam. The subsoil is about 25 inches thick. It consists of an 8-inch layer of yellowish-brown, friable loam; a 4-inch layer of dark yellowish-brown, firm, stratified loam, silt loam, and fine sandy loam; and a 13-inch layer of yellowish-brown, firm silt loam. The underlying material, at a depth of 37 inches, is light yellowish-brown, friable, limy, stratified silt loam and very fine sand.

Fertility is high, and permeability is moderate to moderately rapid. The available water capacity is moderately high; crops seldom lack sufficient water.

Corn, small grain, and forage crops are the common crops.

Typical profile of a Sisson very fine sandy loam:

Ap—0 to 9 inches, dark-brown (10YR 4/3) very fine sandy loam; moderate, medium, granular structure; friable; neutral; abrupt, wavy boundary.

A2—9 to 12 inches, light yellowish-brown (10YR 6/4) very fine sandy loam; weak, medium, platy structure; friable; slightly acid; gradual, wavy boundary.

B21t—12 to 20 inches, yellowish-brown (10YR 5/4) loam; weak, medium, subangular blocky structure; friable; slightly acid; gradual, wavy boundary.

B22—20 to 24 inches, dark yellowish-brown (10YR 4/4) stratified loam, silt loam, and fine sandy loam; moderate, medium, subangular blocky structure; firm; slightly acid; gradual, wavy boundary.

B23—24 to 37 inches, yellowish-brown (10YR 5/4) silt loam; weak, medium, subangular blocky structure; firm; pale-brown (10YR 6/3) very fine sandy loam coats on ped faces; mildly alkaline; abrupt, wavy boundary.

C—37 to 60 inches +, light yellowish-brown (10YR 6/4) stratified silt loam and very fine sand; weak, thin, platy structure; friable; calcareous.

In areas not yet farmed, there is a very dark gray or very dark grayish-brown A1 horizon 1 to 3 inches thick. The color of the Ap horizon ranges to brown and dark grayish brown, and the thickness of that horizon ranges from 7 to 10 inches. The texture of the B horizon ranges to heavy silt loam, heavy very fine sandy loam, loam, and light silty clay loam. The reaction of the A and B horizons ranges from slightly acid to mildly alkaline.

Sisson soils are slightly coarser textured than Miami soils. They formed in material similar to that in which Tuscola and Kibbie soils formed, but they are better drained than those soils and lack mottling. Sisson soils are finer textured than Spinks soils.

Sisson very fine sandy loam, 2 to 6 percent slopes (SfB).—This soil is on lake plains and outwash plains throughout the county. It has uniform, short to medium-length slopes. Included in the larger areas mapped were small areas of Tuscola and Kibbie soils.

A moderate hazard of erosion, especially on slopes of more than 4 percent, is the main limitation for farming.

Corn, small grain, and forage crops are the most important crops grown. (Capability unit IIe–2 (2.5a); woodland suitability group U)

Sisson very fine sandy loam, 2 to 6 percent slopes, moderately eroded (SfB2).—This soil occurs as a few small areas on outwash plains and lake plains throughout the county. It has short slopes. The plow layer is brown. In most areas it contains a little yellowish-brown loam plowed up from the subsoil. It is less fertile, contains less organic matter, and has poorer tilth than the plow layer of uneroded Sisson soils. Included in mapping were a few spots of Sisson soils so severely eroded that the subsoil is exposed.

A moderate hazard of further erosion is the main limitation for farming.

Corn, small grain, and forage crops are the main crops. (Capability unit IIe–2 (2.5a); woodland suitability group U)

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Sisson very fine sandy loam, 6 to 12 percent slopes (SfC).—This soil occurs as a few small areas on low moraines throughout the county. It has short, uniform to irregular slopes.

The severe hazard of erosion is the main limitation for farming. Contour tillage and contour stripcropping, which help to control erosion, are not practical where the slopes are irregular.

Corn, small grain, and forage crops are the main crops. A close-growing crop in the cropping system helps to check erosion. (Capability unit IIIe–5 (2.5a); woodland suitability group U)

Sisson very fine sandy loam, 6 to 12 percent slopes, moderately eroded (SfC2).—This soil occurs as small areas on low moraines throughout the county. It has uniform to irregular, generally short slopes. In most areas the plow layer contains a little yellowish-brown loam plowed up from the subsoil. It is less fertile and contains less organic matter than the plow layer of uneroded Sisson soils. Included in mapping were small areas of less sloping Sisson soils on knolls and hilltops and a few spots of Sisson soils so severely eroded that the subsoil is exposed.

The hazard of further erosion is a severe limitation for farming. Contour tillage and contour stripcropping, which help to control erosion, are not practical where the slopes are irregular.

Corn, small grain, and forage crops are grown. (Capability unit IIIe–5 (2.5a); woodland suitability group U)

Sloan Series

The Sloan series is made up of poorly drained, level or depressional soils on flood plains. These soils formed in water-deposited loam, silty clay loam, and silt loam. They are subject to flooding in spring and in wet weather in other seasons.

In a typical profile, the surface layer is very dark brown loam about 12 inches thick. The subsoil is about 22 inches thick. The upper 12 inches is gray, friable loam mottled with dark yellowish brown, and the lower 10 inches is light-gray, firm silt loam mottled with strong brown. The underlying material, at a depth of about 34 inches, is dark-gray, friable, limy silt loam mottled with brownish yellow and containing thin layers of fine sand and loam.

Fertility is high, permeability is variable, and the available water capacity is high. The water table is within 12 inches of the surface unless lowered by artificial drainage.

Most of the acreage is in woods.

Typical profile of Sloan loam:

A1—0 to 12 inches, very dark brown (10YR 2/2) loam; moderate, fine, granular structure; friable; neutral; gradual, wavy boundary.

B21g—12 to 24 inches, gray (5Y 5/1) loam; few, medium, distinct, dark yellowish-brown (10YR 4/4) mottles; very weak, coarse, subangular blocky structure; friable; mildly alkaline; gradual, wavy boundary.

B22g—24 to 34 inches, light-gray (5Y 6/1) silt loam; few, medium, distinct, strong-brown (7.5YR 5/6) mottles; very weak, coarse, subangular blocky structure; firm; mildly alkaline; abrupt, wavy boundary.

IICg—34 to 54 inches +, dark-gray (10YR 4/1) silt loam; thin layers of fine sand and loam; few, fine, distinct, brownish-yellow (10YR 6/6) mottles; massive; friable; calcareous.

The color of the A horizon is black in some areas, and the thickness of that horizon ranges from 10 to 14 inches. The texture of the B horizon ranges to light silty clay loam or loam and silt loam stratified with thin layers of sandy loam and fine sand. The reaction of the A horizon ranges from neutral to mildly alkaline.

Sloan soils have more silt in the B and C horizons than Cohoctah soils. They have finer textured B and C horizons than Glendora soils.

Sloan loam (0 to 1 percent slopes) (Sn).—This soil is on the flood plains of rivers and streams throughout the county. The surface layer is very dark brown. In depressions the texture of the surface layer is silt loam rather than loam. In a few areas the subsoil and underlying material consist of clay loam or silty clay loam.

Flooding early in spring limits the use of this soil for crops and even for pasture. Many of the areas are cut by meandering streams into fields so small that drainage and farming are impractical. Other limitations are a high water table and a hazard of frost damage.

Most areas of this soil are in woods. Small areas are used for corn, native pasture, and hay. (Capability unit IIIw–12 (L–2c); woodland suitability group O)

Spalding Series

The Spalding series is made up of very poorly drained, level to depressional, organic soils in glacial drainageways and on moraines. These soils consist of undecomposed remains of woody and fibrous plants. The organic material is more than 42 inches thick.

In a typical profile, the surface layer is dark grayish-brown peat about 3 inches thick. Below this is 21 inches of dark reddish-brown, soft peat, the upper 5 inches of which contains the matted remains of coarse grasses. At a depth of 24 inches is yellow, soft peat that contains pieces of tree roots and other woody fragments.

Fertility is low, permeability is rapid, and the available water capacity is high. Runoff is very slow, and water ponds in the lowest areas. The water table is at or near the surface most of the year. These soils are extremely acid to strongly acid and are generally low in phosphorus, potassium, and many micronutrients.

These soils are difficult to farm. Nearly all the acreage remains in native vegetation. A few areas are drained and used to grow blueberries.

Typical profile of Spalding peat:

1—0 to 3 inches, dark grayish-brown (10YR 4/2) peat; moderate, medium, granular structure; very friable; extremely acid; abrupt, smooth boundary.

2—3 to 8 inches, dark reddish-brown (2.5YR 2/4) peat; soft; matted; contains remains of coarse-bladed grass; extremely acid; clear, wavy boundary.

3—8 to 24 inches, dark reddish-brown (5YR 3/4) peat; massive; soft; extremely acid; gradual, wavy boundary.

4—24 to 48 inches +, yellow (10YR 7/8) peat; massive; soft; fibrous; contains pieces of tree roots and other woody fragments; very strongly acid.

The color of the surface layer ranges to dark reddish brown and brown, and that of the second and third layers to yellowish brown. In some areas the profile contains partly decomposed logs and tree roots. The thickness of the organic material is at least 42 inches and ranges to 10 feet or even more. The reaction is extremely acid to strongly acid.

Spalding soils are more acid than either Houghton or

Carlisle soils. They have a thicker layer of organic material and are more acid than either Adrian or Tawas soils. They contain more woody fragments than Greenwood soils.

Spalding-Greenwood peats (0 to 1 percent slopes) (So).—This complex occurs in boglike areas in glacial drainageways and on moraines throughout the county. Most of the areas mapped consist of about equal acreages of Spalding peat and Greenwood peat in such intricate patterns that neither could be shown separately on the soil map. Spalding peat makes up a slightly larger part of some areas than Greenwood peat. Greenwood peat is described under the heading "Greenwood Series."

The use of these soils is limited by a high water table, low fertility, and an extremely acid reaction. Artificial drainage is difficult because many areas lack outlets, and effective drainage is likely to cause the organic material to settle. Wind erosion and frost damage are serious hazards.

Nearly all areas of this complex are still in native vegetation. Blueberries are grown on a few areas that have been drained. Peat for commercial use has been obtained from many areas of Spalding peat. (Capability unit IVw–1 (Mc–a); woodland suitability group J)

Spinks Series

The Spinks series is made up of well-drained, level to very steep soils on outwash plains, till plains, and moraines. These soils formed in sand and loamy sand.

In a typical profile, the surface layer is brown loamy sand about 9 inches thick. The subsurface layer, about 10 inches thick, is light yellowish-brown, loose sand. The subsoil is about 45 inches thick. It consists of alternate layers of brown, very friable loamy sand and pale-brown, loose sand. The layers of loamy sand are ¼ inch to 2 inches thick, and the layers of sand 2 to 9 inches thick. The underlying material, at a depth of about 64 inches, is light-gray, loose, mildly alkaline sand.

Fertility is low, permeability is moderately rapid, and the available water capacity is moderately low. Runoff is slow to rapid, depending on the slope. Normally the soils are filled to capacity with available water at the start of the growing season, but rainfall during the season is generally not adequate to replace the water used by plants, and crops can be affected by a shortage of available water following a period of dry weather.

The level to sloping soils of the Spinks series are used for crops and pasture. The steeper ones are in woods or are idle and growing up to brush. Trees have been planted on many areas that formerly were farmed.

Typical profile of a Spinks loamy sand:

Ap—0 to 9 inches, brown (10YR 4/3) loamy sand; weak, fine, granular structure; very friable; medium acid; abrupt, smooth boundary.

A2—9 to 19 inches, light yellowish-brown (10YR 6/4) sand; single grain; loose; slightly acid; abrupt, wavy boundary.

A2–Bt—19 to 64 inches, ¼-inch to 2-inch discontinuous layers of brown (7.5YR 4/4) loamy sand, representing the Bt horizon, and 2-inch to 9-inch layers of pale-brown (10YR 6/3) sand, representing the A2 horizon; the Bt horizons are massive and very friable; the A2 horizon is single grain and loose; both are slightly acid; abrupt, wavy boundary.

C—64 to 72 inches +, light-gray (10YR 7/2) sand; single grain; loose; mildly alkaline.

In undisturbed areas there is a very dark brownish-gray A1 horizon 1 to 3 inches thick. The depth to the uppermost layer of loamy sand in the A2–Bt horizon ranges from 15 inches to about 36 inches. In a few areas the color of the A2–Bt horizon is reddish brown. The texture of the Bt layers is sandy loam in a few places. The reaction of the A and B horizons ranges from medium acid to mildly alkaline.

Spinks soils have a coarser textured subsoil than Oshtemo or Boyer soils. The multiple Bt horizons in Spinks soils are closer to the surface than the multiple B't horizons in Chelsea soils.

Spinks loamy sand, 0 to 2 percent slopes (SpA).—This soil occurs mainly on outwash plains in the southern part of the county. Unprotected areas have been slightly affected by soil blowing. Included in mapping were a few areas of the poorly drained Granby soils and the very poorly drained Tawas soils in swales and depressions. These included soils dry out more slowly than the surrounding Spinks soil.

The available water capacity is moderately low, and crops are affected by a shortage of moisture in most years. The hazard of water erosion is not significant, but protection against soil blowing is needed.

Almost all of this soil is used for crops, mainly corn, small grain, and forage crops. (Capability unit IIIs–3 (4a); woodland suitability group E)

Spinks loamy sand, 2 to 6 percent slopes (SpB).—This soil is on outwash plains and till plains in the southern part of the county. On the uplands, the slopes are short to medium in length; on the outwash plains, the slopes are long and undulating. Areas that have been cultivated and not adequately protected have been slightly affected by water erosion and soil blowing.

A shortage of available water during the growing season is the main limitation for farming. Other limitations are low fertility and the hazard of soil blowing.

Potatoes and small grain are grown on most of this soil. Corn, forage crops, and pasture crops are grown on smaller acreages. (Capability unit IIIs–4 (4a); woodland suitability group E)

Spinks loamy sand, 6 to 12 percent slopes (SpC).—This soil is on moraines in the southern part of the county. It has short, irregular slopes. The plow layer in some areas contains some light yellowish-brown sand plowed up from the subsurface layer.

The hazard of erosion is the main limitation for farming. Other limitations are low fertility and the shortage of available water during the growing season.

All of this soil is or has been in cultivation. Small grain, forage crops, and pasture are the main crops. (Capability unit IIIe–9 (4a); woodland suitability group E)

Spinks loamy sand, 12 to 18 percent slopes (SpD).—This soil occurs as small areas on moraines in the southern part of the county. It has short, irregular slopes. The surface layer in most places is brown, but where organic matter has accumulated, the uppermost several inches of the surface layer are dark gray.

The hazard of erosion limits the use of this soil for crops. The slope and the sandy texture make the use of farm machinery difficult, and the shortage of available water restricts the growth of crops.

Much of this soil is in woods or in native pasture. Most areas that are farmed are used for forage crops or pasture. Vegetation that helps to check erosion should be

maintained in most years. (Capability unit IVe–9 (4a); woodland suitability group E)

Spinks loamy sand, 18 to 25 percent slopes (SpE).—This soil is on moraines in the southern part of the county. It has short, irregular slopes that vary considerably in gradient within short distances. In undisturbed areas the very dark brownish-gray surface layer is 1 to 3 inches thick. In cultivated areas the plow layer is brown and in places contains a little light yellowish-brown sand plowed up from the subsurface layer. Included in mapping were areas of less sloping Spinks soils on hills and knolls and at the base of slopes.

The slope, the resulting erosion hazard, and the shortage of available water make this soil unsuitable for farming.

Nearly all of this soil is in woods. Either trees or some other permanent vegetation should be maintained at all times. (Capability unit VIe–2 (4a); woodland suitability group E)

Spinks loamy sand, 25 to 50 percent slopes (SpF).—This soil occurs as small areas on moraines in the southern part of the county. Mainly, it has short, irregular slopes that vary considerably in gradient within short distances, but there are very short, uniform slopes that form bluffs along major drainageways and around other bodies of water. Included in mapping were areas of less sloping Spinks soils on hills and knolls and at the base of slopes.

The slope, the resulting erosion hazard, and the shortage of available water make this soil unsuitable for farming.

Nearly all of the acreage is in woods. Trees or other permanent vegetation should be maintained at all times. (Capability unit VIIe–2 (4a); woodland suitability group E)

Tawas Series

The Tawas series is made up of very poorly drained, level or depressional, organic soils on till plains, outwash plains, lake plains, and moraines. These soils formed in the remains of trees, reeds, sedges, and grasses. Sand underlies the organic material at a depth of 12 to 42 inches.

In a typical profile, the surface layer is black muck about 18 inches thick. Below the surface layer is a 14-inch layer of very dark gray, very friable muck that contains pieces of partly decomposed wood. Light-gray, loose, limy sand underlies the organic material at a depth of 32 inches.

Fertility is low. Permeability is rapid in the organic layers and very rapid in the sandy underlying material. The available water capacity is high; the supply is usually adequate for plants. Runoff is very slow, and water ponds in some of the lowest spots. The water table is at or near the surface unless lowered by artificial drainage. The organic material settles readily if the soils are drained and cultivated.

Where drained, these soils are planted to truck crops. The areas not drained are in woods or in pasture.

Typical profile of Tawas muck:

1—0 to 18 inches, black (5YR 2/1) muck; moderate, fine, granular structure; very friable; medium acid; gradual, wavy boundary.

2—18 to 32 inches, very dark gray (5YR 3/1) muck; weak, medium, granular structure; very friable; contains numerous, various-sized pieces of partially decomposed wood; medium acid; abrupt, wavy boundary.

IICg—32 to 48 inches +, light-gray (5Y 6/1) sand; single grain; loose; calcareous.

In a few areas the color of the surface layer is very dark brown. In thickness, this layer ranges from 12 to 24 inches. The organic material below a depth of 24 inches is peaty muck or peat in some areas. The reaction of the organic material ranges from medium acid to neutral.

Tawas soils have a thinner layer of organic material than either Carlisle or Houghton soils. They differ from Linwood soils in being underlain with sand instead of silt loam.

Tawas muck (0 to 1 percent slopes) (Ta).—This soil is in swampy depressions throughout the county.

Excessive wetness and low fertility are the main limitations. Artificial drainage is difficult because the underlying sand tends to cave into ditches and tile trenches. Farm machinery bogs down when the soil is wet. Lowering the water table too much can cause the organic material to settle. The supplies of phosphorus, potassium, and micronutrients are inadequate. Frost damage is a hazard to crops in low spots. Fire and soil blowing can reduce the thickness of the organic material.

If drained, fertilized, and protected against the wind, this soil is suited to many short-season, frost-resistant crops. Most of the larger areas have been drained and are cultivated. The smaller areas are in woods. (Capability unit IVw–5 (M/4c); woodland suitability group J)

Tedrow Series

The Tedrow series is made up of somewhat poorly drained, level to gently sloping soils on outwash plains. These soils formed in sand and loamy sand material.

In a typical profile, the surface layer is dark grayish-brown loamy sand about 11 inches thick. The subsoil, about 5 inches thick, is yellowish-brown, very friable loamy fine sand. The underlying material, to a depth of about 23 inches, is pale-brown, very friable loamy fine sand mottled with yellowish brown. Below a depth of 23 inches is light brownish-gray and gray, loose, limy fine sand mottled with yellowish brown.

Fertility is low, permeability is moderately rapid, the available water capacity is moderately low, and runoff is slow to ponded. The water table is high in spring unless lowered by artificial drainage. If drained the soils are easy to work but are apt to become droughty.

Some areas of these soils are used for crops, some are used for pasture, and some are in woods.

Typical profile of a Tedrow loamy sand:

Ap—0 to 11 inches, dark grayish-brown (10YR 4/2) loamy sand; weak, medium, granular structure; very friable; medium acid; abrupt, wavy boundary.

B1—11 to 16 inches, yellowish-brown (10YR 5/4) loamy fine sand; very weak, medium, granular structure; very friable; medium acid; abrupt, irregular boundary.

C1—16 to 23 inches, pale-brown (10YR 6/3) loamy fine sand; many, coarse, distinct, yellowish-brown (10YR 5/6) mottles; weak, thick, platy structure; very friable; neutral; gradual, wavy boundary.

IIC2—23 to 40 inches, light brownish-gray (2.5Y 6/2) fine sand; many, coarse, distinct, yellowish-brown (10YR 5/6) mottles; single grain; loose; mildly alkaline; abrupt, wavy boundary.

IIC3g—40 to 60 inches +, gray (10YR 6/1) fine sand; occasional thin strata of silt; fine, medium, distinct,

brownish-yellow (10YR 6/6) mottles; single grain; loose; calcareous.

In areas not yet farmed, there is a very dark gray or black A1 horizon 2 to 4 inches thick and a light brownish-gray A2 horizon 2 to 5 inches thick. The reaction, to a depth of about 23 inches, is medium acid to mildly alkaline. The depth to the IIC3g horizon ranges from 24 to 48 inches.

Tedrow soils formed in material similar to that in which Spinks soils formed, but Tedrow soils are less well drained than Spinks soils and lack the A2–Bt horizon that is characteristic of Spinks soils. Tedrow soils lack the stratified sand and gravel underlying material that is characteristic of Wasepi and Brady soils.

Tedrow loamy sand, 0 to 2 percent slopes (TeA).—This soil is on outwash plains in the northern part of the county. Included in mapping were small areas of Granby soils in depressions and drainageways. These included soils dry out more slowly than the surrounding Tedrow soil.

Excessive wetness and low fertility are the major limitations for farming. Tile drains, open ditches, and surface drains are needed to make production of crops practical. Ditches and tile trenches cave in readily, because the sandy soil material is unstable when wet.

Corn and forage crops are the most common crops. Some small areas are in native pasture, and some have been abandoned. (Capability unit IIIw–5 (4b); woodland suitability group F)

Tedrow loamy sand, 2 to 6 percent slopes (TeB).—This soil is on outwash plains in the northern part of the county. It has uniform, medium-length, undulating slopes. The plow layer in some areas contains yellowish-brown loamy fine sand plowed up from the subsoil. Included in mapping were small areas of level Granby soils in drainageways. These included soils dry out more slowly than the surrounding Tedrow soil.

Excessive wetness and low fertility are the main limitations for farming. Artificial drainage is needed to make the production of crops practical. Installing a complete drainage system is difficult because of the undulating relief, but a combination of surface drains with random tile and ditches is effective.

Corn and forage crops are the common crops. Some small areas are used for native pasture, and some have been abandoned. (Capability unit IIIw–5 (4b); woodland suitability group F)

Tonkey Series

The Tonkey series is made up of poorly drained, level or depressional soils on lake plains and outwash plains. These soils formed in stratified fine sandy loam, sandy loam, and loamy sand.

In a typical profile, the surface layer is very dark grayish-brown fine sandy loam about 8 inches thick. The subsoil is about 29 inches thick. It consists of a 12-inch layer of dark-gray, friable sandy loam, a 4-inch layer of gray, very friable sandy loam, and a 13-inch layer of yellowish-brown, friable heavy fine sandy loam mottled with grayish brown. The underlying material, at a depth of about 37 inches, is gray, very friable, mildly alkaline, stratified loamy sand, sandy loam, and fine sandy loam mottled with yellowish brown.

Fertility is moderate, permeability is moderate, and the available water capacity is moderate. The supply of water available to plants is generally adequate. Runoff is very slow, and water ponds in depressions. The water table is high in spring and after rain in other seasons. If the water table is lowered by artificial drainage, the soils are easy to work and to keep in good tilth.

If drained, these soils are suited to most of the crops commonly grown in the county. Small grain is likely to drown out or to lodge if planted in undrained areas.

Typical profile of Tonkey fine sandy loam:

A1—0 to 8 inches, very dark grayish-brown (10YR 3/2) fine sandy loam; weak, medium, granular structure; very friable; slightly acid; abrupt, wavy boundary.

B21g—8 to 20 inches, dark-gray (10YR 4/1) sandy loam; moderate, medium, granular structure; friable; neutral; gradual, wavy boundary.

B22g—20 to 24 inches, gray (10YR 5/1) sandy loam; weak, fine, subangular blocky structure; very friable; neutral; gradual, wavy boundary.

B23—24 to 37 inches, yellowish-brown (10YR 5/8) heavy fine sandy loam; many, coarse, distinct, grayish-brown (2.5Y 5/2) mottles; weak, medium, subangular blocky structure; friable; contains many ½-inch to 2-inch lenses of silt loam and loamy sand; mildly alkaline; gradual, wavy boundary.

IICg—37 to 42 inches +, gray (10YR 5/1), stratified loamy sand, sandy loam, and fine sandy loam; common, medium, distinct, yellowish-brown (10YR 5/8) mottles; massive; very friable; mildly alkaline.

In a few undisturbed areas, a layer of muck less than 12 inches thick is at the surface. In cultivated areas there is a black or very dark grayish-brown Ap horizon 6 to 9 inches thick. The texture of the B horizon varies within short distances; it includes sandy loam, fine sandy loam, stratified sandy loam and loamy sand, and thin layers of loam, silt loam, and sand. The depth to the C horizon ranges from 24 to 44 inches. The reaction of the A and B horizons ranges from slightly acid to mildly alkaline. In some places the C horizon is calcareous.

Tonkey soils have a coarser textured subsoil than Colwood soils. They are more poorly drained than Richter soils. They have a finer textured subsoil than Granby soils.

Tonkey fine sandy loam (0 to 1 percent slopes) (To).—This soil occurs on lake plains and outwash plains in the central and northern parts of the county. Included in mapping were a few areas of Mussey, Gilford, and Linwood soils in depressions and natural drainageways.

Excessive wetness is the main limitation of this Tonkey soil. Most areas are too wet to be farmed unless artificially drained. The soil material is unstable, and ditches and tile trenches cave in readily; consequently, it is best to install tile during periods of dry weather. Special blinding material is needed to keep soil material from flowing into and filling tile drains. Surface drains are needed in some areas to remove ponded water from depressions.

If drained, this soil is well suited to corn and other cultivated crops. Most of the acreage is farmed. (Capability unit IIw–6 (3c); woodland suitability group W)

Tuscola Series

The Tuscola series is made up of moderately well drained, level to gently sloping soils on lake plains and outwash plains. These soils formed in stratified silt, very fine sand, and fine sand.

In a typical profile, the surface layer is dark grayish-brown very fine sandy loam about 7 inches thick. The subsurface layer, about 4 inches thick, is brown, friable

loam. The subsoil is about 25 inches thick. The upper 11 inches is yellowish-brown, firm loam, and the lower 14 inches is brown, firm silt loam mottled with light yellowish brown and light brownish gray. The underlying material, at a depth of about 36 inches, is pale-brown, very friable, limy, stratified silt, fine sand, and very fine sand mottled with yellowish brown.

Fertility is high, permeability is moderate, and the available water capacity is high. The supply of water available to crops is generally adequate. Runoff is slow to moderately slow, depending on the slope.

All crops commonly grown in the county can be grown on these soils.

Typical profile of a Tuscola very fine sandy loam:

Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) very fine sandy loam; weak, medium, granular structure; friable; slightly acid; abrupt, wavy boundary.

A2—7 to 11 inches, brown (10YR 5/3) loam; moderate, medium, granular structure; friable; slightly acid; abrupt, wavy boundary.

B21—11 to 22 inches, yellowish-brown (10YR 5/4) loam; moderate, medium, subangular blocky structure; firm; neutral; gradual, wavy boundary.

B22—22 to 36 inches, brown (10YR 4/3) silt loam; common, medium, distinct, light yellowish-brown (10YR 6/4) and light brownish-gray (10YR 6/2) mottles below a depth of 24 inches; moderate, medium, subangular blocky structure; firm; neutral; abrupt, wavy boundary.

IIC—36 to 42 inches +, pale-brown (10YR 6/3) finely stratified silt, fine sand, and very fine sand; common, medium, distinct, yellowish-brown (10YR 5/4) mottles; massive; very friable; calcareous.

In areas not yet farmed, there is a very dark grayish-brown A1 horizon 1 to 3 inches thick. The color of the Ap horizon in some places is brown, and the thickness of that horizon ranges from 6 to 9 inches. The texture of the B21 horizon ranges to light silt loam or heavy fine sandy loam, and that of the B22 horizon to loam, light silty clay loam, or heavy fine sandy loam. Mottling begins at a depth of 16 to about 30 inches. The thickness of the A and B horizons combined ranges from 24 to about 44 inches. The reaction of the A and B horizons ranges from medium acid to neutral.

Tuscola soils formed in material similar to that in which Sisson soils formed, but they differ from Sisson soils in being mottled in the lower part of the B horizon. Tuscola soils are better drained and less mottled than Kibbie soils. They have a stratified C horizon, more varied in texture than the C horizon of Miami or Celina soils.

Tuscola very fine sandy loam, 0 to 2 percent slopes (TuA).—This soil occurs on lake plains and outwash plains throughout the county. Included in mapping were a few small areas of the more poorly drained Kibbie soils in depressions.

This Tuscola soil has no serious limitations for farming. It is easy to cultivate, and the erosion hazard is not significant.

Nearly all the acreage is intensively farmed. Corn, small grain, and forage crops are common crops. (Capability unit I–1 (2.5a); woodland suitability group U)

Tuscola very fine sandy loam, 2 to 6 percent slopes (TuB).—This soil occurs on lake plains and outwash plains throughout the county. It has uniform, medium-length to long slopes. Included in mapping were a few areas of the more poorly drained Kibbie soils in depressions and of the better drained Sisson soils at higher elevations.

A moderate hazard of erosion is the main limitation of this Tuscola soil.

Nearly all the acreage is farmed intensively. Much of it is used for corn, small grain, and forage crops. (Capability unit IIe–2 (2.5a); woodland suitability group U)

Ubly Series

The Ubly series is made up of well drained to moderately well drained, level to undulating soils on outwash plains, till plains, and moraines. These soils formed in sandy loam and loam underlain at a depth of 18 to 42 inches with loam, clay loam, and silty clay loam.

In a typical profile, the surface layer is dark grayish-brown sandy loam about 11 inches thick. The subsoil is about 15 inches thick. The upper 7 inches is yellowish-brown, very friable sandy loam, and the lower 8 inches is yellowish-brown, friable heavy gravelly loam. The underlying material, at a depth of about 26 inches, is pale-brown, loose, limy coarse sand and gravel. At a depth of 34 inches is brown, firm, limy clay loam.

Fertility is moderate, permeability is moderate, the available water capacity is moderate, and runoff is slow. The supply of available water is generally adequate, but a shortage sometimes develops in midsummer.

Most of the acreage of Ubly soils is farmed. Corn, small grain, and forage crops are the common crops. A few areas remain in woods, and a few are used for pasture.

Typical profile of an Ubly sandy loam:

Ap—0 to 11 inches, dark grayish-brown (10YR 4/2) sandy loam; weak, fine, granular structure; very friable; slightly acid; abrupt, smooth boundary.

B1r—11 to 18 inches, yellowish-brown (10YR 5/6) sandy loam; weak, medium, granular structure; very friable; neutral; clear, wavy boundary.

B2t—18 to 26 inches, yellowish-brown (10YR 5/6) gravelly heavy loam; moderate, medium, subangular blocky structure; friable when moist, slightly sticky when wet; neutral; abrupt, irregular boundary.

IIC1—26 to 34 inches, pale-brown (10YR 6/3) coarse sand and gravel; single grain; loose; calcareous; abrupt, smooth boundary.

IIIC2—34 to 44 inches +, brown (10YR 5/3) clay loam; moderate, medium, angular blocky structure; firm; calcareous.

In undisturbed areas there is a very dark grayish-brown A1 horizon 1 to 3 inches thick and a grayish-brown or light brownish-gray A2 horizon 3 to 6 inches thick. The texture of the lower part of the B2t horizon is gravelly loam or light clay loam in a few areas. The texture of the IIIC2 horizon is loam, clay loam, or silty clay loam. The reaction of the A and B horizons is slightly acid to neutral.

Ubly soils formed in material similar to that in which Belding soils formed, but they are better drained than Belding soil and are not mottled. Ubly soils have a coarser textured B horizon than Miami or Celina soils. They have finer textured underlying material than McBride or Lapeer soils.

Ubly sandy loam, 0 to 2 percent slopes (UbA).—This soil occurs as a few areas on outwash plains and till plains in the central and northern parts of the county. The plow layer in some areas contains a considerable amount of gravel and cobblestones.

The available water capacity is only moderate, and a shortage of water in midsummer is the main limitation for farming. Runoff is slow, and the erosion hazard is not significant.

Corn, small grain, and forage crops are the principal crops. (Capability unit IIs–2 (3/2a); woodland suitability group U)

Ubly sandy loam, 2 to 6 percent slopes (UbB).—This soil occurs on till plains and moraines in the central and northern parts of the county. It has irregular, short to medium-length slopes. The plow layer in some areas contains gravel and cobblestones.

A moderate hazard of erosion is the main limitation for farming.

Corn, small grain, and forage crops can be grown. (Capability unit IIe–3 (3/2a); woodland suitability group U)

Warners Series

The Warners series is made up of very poorly drained, level or depressional soils on lake plains and outwash plains. These soils formed in organic material less than 12 inches thick over marl.

In a typical profile, the surface layer is black muck about 7 inches thick. Below this is light-gray, calcareous marl that contains many small shells.

Fertility is low. Permeability varies because of variations in the composition of the marl. The available water capacity is high. The water table is at the surface unless lowered by artificial drainage.

Most of the acreage is in native vegetation.

Typical profile of Warners muck:

1—0 to 7 inches, black (10YR 2/1) muck; weak, fine, granular structure; very friable; mildly alkaline; abrupt, wavy boundary.

IIC—7 to 42 inches +, light-gray (10YR 7/1) marl; massive; contains a high percentage of small shells; calcareous.

The color of the surface layer in a few areas is very dark brown, and the thickness of that layer ranges from 6 to 12 inches. In a few places this layer contains sand and silt or small pieces of marl. The consistence of the underlying marl ranges from soft to firm, and the shell content varies.

Warners soils formed in material similar to that in which Edwards soils formed, but Warners soils are shallower over marl than Edwards soils. They have a thinner layer of organic material than either the medium acid Tawas soils, which are underlain with sand, or the slightly acid Linwood soils, which are underlain with silt loam.

Warners muck and marl (0 to 1 percent slopes) (Wb).—This soil occurs in low, swampy areas and on the borders of lakes. Included in mapping were small areas in which marl is at the surface.

Excessive wetness, shallowness, alkalinity, and low fertility limit the use of this soil for farming. Artificial drainage is difficult because the marl is so near the surface and because many areas lack outlets. Frost damage is a hazard.

Most of this soil is in native grass and brush. (Capability unit IVw–6 (M/mc); woodland suitability group J)

Wasepi Series

The Wasepi series is made up of somewhat poorly drained, level to undulating soils on outwash plains and lake plains. These soils formed in sandy loam or loamy sand 24 to 42 inches thick over stratified coarse sand and gravel.

In a typical profile, the surface layer is very dark grayish-brown loamy sand about 7 inches thick. The subsurface layer, about 4 inches thick, is brown, very friable loamy sand mottled with dark yellowish brown and dark grayish brown. The subsoil is about 21 inches thick. It consists of a 3-inch layer of brown, friable sandy loam mottled with yellowish brown and dark grayish brown; a 10-inch layer of grayish-brown, firm heavy sandy loam mottled with yellowish brown and dark grayish brown; and an 8-inch layer of grayish-brown, very friable light sandy loam mottled with yellowish brown. The underlying material, at a depth of about 32 inches, is light olive-brown, loose, limy, stratified sand and gravel.

Fertility is moderate to low, and the available water capacity is moderate to low. The water table is seasonally high. Permeability is moderately rapid except while the water table is high. The mottling in the profile is a result of the fluctuating high water table. If drained artificially these soils are quick to dry out and are easy to cultivate.

Drained areas of these soils are used for corn, small grain, and forage crops. Some of the undrained areas are in woods, and some are used for pasture.

Typical profile of a Wasepi loamy sand:

Ap—0 to 7 inches, very dark grayish-brown (10YR 3/2) loamy sand; weak, fine, granular structure; very friable; moderately high organic-matter content; slightly acid; abrupt, smooth boundary.

A2—7 to 11 inches, brown (10YR 5/3) loamy sand; common, medium, distinct, dark yellowish-brown (10YR 4/4) and dark grayish-brown (10YR 4/2) mottles; weak, fine, granular structure; very friable; slightly acid; clear, wavy boundary.

B21t—11 to 14 inches, brown (10YR 5/3) sandy loam; common, medium, distinct, yellowish-brown (10YR 5/6) and dark grayish-brown (10YR 4/2) mottles; weak, medium, subangular blocky structure; friable; slightly acid; clear, wavy boundary.

B22tg—14 to 24 inches, grayish-brown (10YR 5/2) heavy sandy loam; common, medium, distinct, yellowish-brown (10YR 5/6) and dark grayish-brown (10YR 4/2) mottles; moderate, medium, subangular blocky structure; firm; slightly acid; clear, wavy boundary.

B3g—24 to 32 inches, grayish-brown (10YR 5/2) light sandy loam; common, medium, distinct, yellowish-brown (10YR 5/4) mottles; weak, coarse, subangular blocky structure; very friable; neutral; abrupt, wavy boundary.

IIC—32 to 48 inches +, light olive-brown (2.5Y 5/4) stratified sand and gravel; single grain; loose; calcareous.

In areas not yet farmed, there is a very dark gray A1 horizon 2 to 4 inches thick. The texture of the B horizon in some areas is light sandy clay loam or gravelly loam; in these areas this horizon is less than 10 inches thick. The depth to the IIC horizon ranges from 24 to about 42 inches. Although dominantly stratified, the IIC horizon consists of coarse sand in some areas and in others mainly of fine gravel. The reaction of the A and B horizons ranges from medium acid to neutral.

Wasepi soils formed in material similar to that in which Gilford soils formed, but they are less poorly drained and less gray than Gilford soils. They are not so well drained as Boyer soils, which are not mottled. They have a thinner B horizon than Brady soils and are less acid.

Wasepi loamy sand, 0 to 2 percent slopes (WsA).—This soil is on outwash plains and lake plains. Included in mapping were areas of Gilford soils in drainageways and depressions. These included soils dry out more slowly than the surrounding Wasepi soil.

Excessive wetness and moderate to low fertility are the main limitations for farming. Most areas cannot be used for crops unless artificially drained. Water that runs off the adjacent uplands accumulates on the surface. Surface drainage is slow, and shallow waterways are needed to remove the water from some areas.

Most of this soil is used for forage or pasture. There are scattered areas of woods. (Capability unit IIIw–5 (4b); woodland suitability group G)

Wasepi loamy sand, 2 to 6 percent slopes (WsB).—This soil is on outwash plains and lake plains. Some unprotected areas, mainly those next to natural drainageways, are slightly eroded. The plow layer in some areas contains a little brown sandy loam plowed up from the subsoil. Included in mapping were small areas of level Wasepi soils.

Excessive wetness and moderate to low fertility are the main limitations for farming. Most areas cannot be used for crops unless artificially drained, and the undulating relief makes it difficult to install a complete drainage system.

Most of this soil is in forage crops or pasture. Scattered areas are in woods. (Capability unit IIIw–5 (4b); woodland suitability group G)

Willette Series

The Willette series is made up of very poorly drained, level or depressional, organic soils on lake plains, till plains, and moraines. These soils formed in the remains of woody and fibrous plants. They are underlain at a depth of 12 to 42 inches with clayey material.

In a typical profile, the surface layer is black muck about 10 inches thick. Below the surface layer is an 18-inch layer of dark reddish-brown, very friable peaty muck, and below that, an 8-inch layer of dark grayish-brown, soft peaty muck. The underlying material, at a depth of 36 inches, is gray, very plastic light silty clay, slightly acid in the upper part and limy at a depth of 40 inches.

Fertility is low. Permeability is rapid in the organic layers and very slow in the silty clay layers. The available water capacity is high; the moisture supply is usually adequate for crops. Runoff is slow to ponded. The water table is at the surface unless lowered by artificial drainage. The organic material settles readily if these soils are drained and farmed.

Drained areas of these soils are planted to truck crops. Undrained areas are in pasture or in woods.

Typical profile of Willette muck:

1—0 to 10 inches, black (10YR 2/1) muck; moderate, fine, granular structure; very friable; slightly acid; abrupt, wavy boundary.

2—10 to 28 inches, dark reddish-brown (5YR 3/2) peaty muck, a mixture of woody and fibrous material; weak, thick, platy structure; very friable; slightly acid; gradual, wavy boundary.

3—28 to 36 inches, dark grayish-brown (10YR 4/2) peaty muck; matted; soft; medium acid; clear, wavy boundary.

IIC1g—36 to 40 inches, gray (N 6/0) light silty clay; massive; very plastic when wet; slightly acid.

IIC2g—40 to 48 inches +, gray (N 6/0) light silty clay; massive; very plastic when wet; calcareous.

The color of the surface layer in a few areas is very dark brown. In places the texture of the underlying material is heavy clay loam or clay. The reaction of the organic material ranges from medium acid to slightly acid.

Willette soils have a thinner layer of organic material than either Carlisle or Houghton soils. They are underlain with silty clay instead of silt loam, like the Linwood soils, or sand, like the Tawas soils.

Willette muck (0 to 1 percent slopes) (Wt).—This soil occurs in low, swampy areas on till plains, lake plains, and moraines throughout the county.

Excessive wetness and low fertility are the main limitations for farming. Drainage is difficult because of underlying clay. The organic material settles if the water table is lowered too much. The supplies of phosphorus, potassium, and micronutrients are deficient. Soil blowing and fire are hazards if crops are grown. Frost is likely to damage crops in the lowest areas.

If artificially drained, adequately fertilized, and protected against blowing, this soil is well suited to many short-season, frost-resistant crops. Some of the smaller areas are covered with trees or brush. (Capability unit IIIw–15 (M/1c); woodland suitability group J)

Use and Management of the Soils

This section begins with an explanation of the system of capability grouping used in the Soil Conservation Service to classify soils according to their relative suitability for general field crops. Following this explanation are discussions of the use and management of the soils of Lapeer County, as grouped according to this system. Next is a table in which are shown predicted yields of the principal crops grown in the county, by individual soils. This is followed by discussions of the use and management of the soils as woodland; for this purpose, the soils are grouped on the basis of similarity in productivity and management needs. Then comes a table that shows the relative suitability of individual soils for the elements of wildlife habitat. The last part of the section concerns soils in engineering; it consists mainly of tables that give descriptions of soil properties significant in engineering and interpretations of these properties as they affect the suitability of the soils for specified engineering uses.

Capability Grouping

Capability grouping shows, in a general way, the suitability of soils for most kinds of field crops. The soils are grouped according to their limitations for field crops, the risk of damage when they are used for such crops, and the way they respond to treatment. The grouping does not take into account major and generally expensive land forming that would change slope, depth, or other characteristics of the soils; it does not take into consideration possible but unlikely major reclamation projects; and it does not apply to rice, cranberries, horticultural crops, or other crops requiring special management.

Those familiar with the capability classification can infer from it much about the behavior of soils when used for other purposes, but this classification is not a substitute for interpretations designed to show the suitability and limitations of groups of soils for forest trees or for engineering.

In the capability system, all kinds of soils are grouped at three levels: the class, the subclass, and the unit. These are discussed in the following paragraphs.

Capability Classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals

indicate progressively greater limitations and narrower choices for practical use, defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants, require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife. (None of the soils of Lapeer County is in class V.)

Class VI soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, woodland, or wildlife.

Class VII soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture or range, woodland, or wildlife.

Class VIII soils and landforms have limitations that preclude their use for commercial plants and restrict their use to recreation, wildlife, water supply, or esthetic purposes.

Capability Subclasses are soil groups within one class; they are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in some parts of the United States but not in Lapeer County, shows that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses, because the soils of this class have few limitations. Class V can contain, at the most, only the subclasses indicated by *w*, *s*, and *c*, because the soils in class V are subject to little or no erosion, though they have other limitations that restrict their use largely to pasture, range, woodland, wildlife, or recreation.

Capability Units are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe–3 or IIIe–6. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraph; and the Arabic numeral specifically identifies the capability unit within each subclass.

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In the following pages the capability units in Lapeer County are described and suggestions for the use and management of the soils are given. The units described are not all numbered consecutively, because not all the units in the statewide classification are represented in Lapeer County. The names of the series represented are mentioned in the description of each unit, but this does not mean necessarily that all the soils of any given series are in that particular unit. The "Guide to Mapping Units," at the back of this publication, gives the names of the individual mapping units and the capability classification of each. The symbols in parentheses following each capability unit designation refer to the management groups in the Michigan State system of classification.

Capability unit I–1 (2.5a)

This unit consists of level, well drained and moderately well drained soils of the Celina, Marlette, and Tuscola series. The Celina and Marlette soils have a moderately fine textured subsoil and medium-textured underlying material. The Tuscola soils have a medium-textured subsoil and are underlain with layers of silt and sand.

Permeability is moderate or moderately slow. The available water capacity is high, and crops seldom lack adequate moisture. The erosion hazard is slight. Fertility is high. A few spots are wet.

All the common crops, including grasses and legumes, are well suited to these soils. Management is easy. Cultivated crops can be grown year after year if tillage is kept to a minimum, organic matter is returned regularly, and a meadow crop is grown occasionally. The use of pastures during wet periods needs to be restricted, so as to prevent compaction of the soils and damage to structure and tilth.

Capability unit IIe–1 (1.5a)

This unit consists of Morley loam, 2 to 6 percent slopes, a well drained to moderately well drained soil that is moderately fine textured in the subsoil and the underlying material.

Permeability is moderately slow because of the moderately fine textured subsoil. The available water capacity is high, and crops seldom lack adequate moisture. Fertility is moderately high, and the organic-matter content is medium to low. This soil warms up rather slowly in spring. A few spots are wet.

Wheat, hay, and corn are the main crops. Control of erosion, preservation of good tilth, and maintenance of the organic-matter content are the major management needs. The cropping sequence should be one that helps to control erosion and that provides for the return of organic matter. Tilling when the soil is wet impairs tilth and causes clodding and compaction; the compaction results in an increase in runoff and a more serious erosion hazard. Fall plowing permits planting early in spring, but it also exposes the soil to erosion. Minimum tillage, stripcropping, the use of fertilizer and green manure, terracing, and providing grassed waterways are other practices that reduce the erosion hazard and improve tilth. Terracing and contour stripcropping are difficult in some areas because of short, complex slopes. Planting and harvesting sometimes have to be delayed because of the wet spots.

Capability unit IIe–2 (2.5a)

This unit consists of gently sloping, well drained and moderately well drained soils of the Celina, Marlette, Miami, Sisson, and Tuscola series. These soils have a moderately fine textured to medium-textured subsoil. The underlying material ranges from stratified silt and fine sand to loam and clay loam. Five of the nine soils in the unit are uneroded or only slightly eroded; the rest are moderately eroded.

The available water capacity is high to moderately high, so crops seldom lack adequate moisture. Fertility is high, and the organic-matter content is medium to low. Permeability is moderate to moderately slow, and runoff is medium. Some areas include seep spots and wet depressions. The moderately eroded soils have a lighter colored surface layer and slightly poorer tilth than the others.

Corn, small grain, and pasture are the crops commonly grown. The erosion hazard is the major limitation for farming. Minimum tillage, terracing, and stripcropping are among the means that can be used to control erosion. Some areas have short, complex slopes, which make terracing and stripcropping infeasible. Establishing grass in natural waterways helps to check gullying. Plowing under crop residues and green-manure crops and applying manure where the soils are moderately eroded are ways of improving tilth and promoting the growth of plants and thus providing additional protection against erosion. In wet years, the seep spots and wet depressions hinder planting and harvesting.

Capability unit IIe–3 (3a, 3/2a)

This unit consists of gently sloping, well drained and moderately well drained soils of the Alcona, Dryden, Fox, Lapeer, McBride, Owosso, and Ubly series. Most of these soils have a moderately coarse textured subsoil underlain with medium-textured to coarse-textured material. A few are moderately eroded.

The available water capacity is moderate; the supply is not adequate to carry crops through a severe drought. Fertility is moderate. Runoff is slow to medium. All but the Owosso soil are moderately permeable. The Owosso soil is moderately rapidly permeable in the upper layers and moderately slowly permeable in the lower layers. The soils that are moderately eroded are less fertile and less resistant to erosion than the others. All of the soils dry out quickly after rain, and they warm up and are ready for tillage early in spring. They are easy to till over a wide range in moisture content.

Corn, oats, wheat, and hay are common crops. Forage crops are well suited. Control of erosion, maintenance of fertility and of the organic-matter content, and conservation of moisture are the main management needs. Terracing, stripcropping, contour tillage, and minimum tillage are among the means that can be used to control erosion. Plowing under manure and crop residues adds organic matter and thus improves tilth and increases the capacity of the soils to absorb water. Winter cover crops supply organic matter and protect the soils against water erosion and blowing. Applications of lime benefit crops, especially legumes.

Capability unit IIw–2 (1c, 1.5b, 1.5c)

This unit consists of level and nearly level, poorly drained and somewhat poorly drained soils of the Blount, Del Rey, Hoytville, Lenawee, and Pewamo series. The subsoil and the underlying material of these soils are fine textured to moderately fine textured.

Fertility is high to moderately high. The available water capacity is high, runoff is slow to ponded, permeability is slow to moderately slow, and the water table is near the surface unless lowered by artificial drainage. Wet depressions are common. The poorly drained soils are slightly higher in organic-matter content than the somewhat poorly drained ones and, consequently, are darker colored. Farm machinery bogs down when the soils are wet, and all farming operations are delayed.

Excessive wetness is the main limitation for farming. The selection of crops depends on the effectiveness of artificial drainage. Both corn and small grain are readily damaged by excessive wetness.

Many areas lack natural outlets and so cannot be drained artificially unless ditches are constructed; other areas are too low to be drained. Tile drains are easily installed, and the trenches are not likely to cave in. Tile lines need to be fairly close together. Backfilling the trenches with straw, topsoil, or other porous material promotes the movement of water into drains. Diversions that intercept runoff from higher adjoining soils are beneficial.

Drainage is the major management need, but maintenance of tilth is also important. The soils puddle if tilled when wet, then dry out hard and cloddy. Plowing under crop residues and green-manure crops helps to preserve good tilth. Fall plowing is less likely to damage tilth than spring plowing, and it also makes planting possible earlier in spring. Frost damage to crops in low spots is a hazard.

Forage crops can be grown if varieties that can tolerate the excessive wetness are selected. Pastures are not ready for grazing early in the season, and they ought not to be grazed in wet weather, because of the tendency of the soils to puddle.

Capability unit IIw–3 (1.5b)

This unit consists of gently sloping and undulating, somewhat poorly drained soils of the Blount and Del Rey series. The subsoil and the underlying material are moderately fine textured.

These soils have a fluctuating high water table that is only a foot or two below the surface in spring. Permeability is slow to moderately slow, and the available water capacity is high. Fertility is moderately high to high. Runoff is slow to medium, and water ponds in the numerous depressions. Many areas are too wet to support farm machinery in spring and after rain in other seasons.

If drained artificially, these soils are well suited to the common crops. The soil material is stable, and ditchbanks and tile trenches need little maintenance. Nevertheless, drainage is difficult and impractical. Because of the undulating topography, only random tile and surface drains can be installed in many areas, and some areas lack outlets for drainage.

If tilled when wet, these soils puddle and then dry out hard and cloddy and with a crust that hinders the emergence of seedlings. Plowing under large amounts of crop residues and green-manure crops improves tilth and reduces the hazard of crusting. Minimum tillage limits the risk of impairing the tilth.

Capability unit IIw–4 (2.5b, 2.5c)

This unit consists of level, poorly drained and somewhat poorly drained soils of the Brookston, Capac, Colwood, Conover, and Kibbie series. These soils have a moderately fine textured subsoil. The underlying material is generally medium textured, but that of the Colwood and Kibbie soils contains coarse-textured strata.

Fertility is high. The available water capacity is high; the moisture supply is usually adequate for optimum growth of plants. Permeability is moderately slow. Runoff is slow, and water ponds in depressions. The water table is high in spring and after rain in other seasons, and runoff from adjacent higher areas contributes to the excessive wetness. Farm machinery bogs down readily during periods of wet weather in spring and fall.

After these soils have been drained and have dried out, they are easy to work and to keep in good tilth and are suited to most kinds of crops commonly grown in the county. The selection of crops depends on how well the soils are drained. The most effective drainage is provided by a combination of tile drains and open ditches. The soil material is stable enough that tile trenches and ditches seldom cave in.

Most crops benefit from applications of lime and fertilizer. Plowing under green-manure crops and crop residues increases the organic-matter content.

Capability unit IIw–5 (2.5b)

This unit consists of gently sloping and undulating, somewhat poorly drained soils of the Capac, Conover, and Kibbie series. These soils have a moderately fine textured subsoil. The underlying material is generally medium textured, but that of the Kibbie soil contains coarse-textured strata.

Fertility is high. The available water capacity is high. Permeability is moderately slow. Water runs off slowly and ponds in the numerous depressions. The water table fluctuates and is only a foot or two below the surface in spring. Many areas are too wet to support machinery in spring and after rain in other seasons.

If drained artificially, these soils are well suited to the crops commonly grown in the county. The soil material is stable enough that ditchbanks and trenches need little maintenance. Nevertheless, drainage is difficult. Because of the undulating topography, only random tile and surface drains can be installed in some areas, and some areas lack outlets for drainage.

If they are tilled when wet, these soils puddle and then dry out hard and cloddy and with a crust that hiners the emergence of seedlings. Plowing under large amounts of crop residues and green-manure crops improves tilth and reduces the hazard of crusting. Minimum tillage limits the risk of impairing tilth.

Capability unit IIw–6 (3b, 3c)

This unit consists of somewhat poorly drained and poorly drained, level soils of the Barry, Locke, Matherton, Richter, Sebewa, and Tonkey series. These soils have a moderately coarse textured to moderately fine textured subsoil. They have medium-textured to coarse-textured underlying material.

These soils are excessively wet in spring and after rain because of a fluctuating high water table. Permeability is moderate or moderately slow. Surface runoff is slow, and water ponds in depressions. The available water capacity is moderate to high, and thus the supply of moisture is generally adequate for optimum growth of crops. Fertility is moderate to moderately high.

Most kinds of crops commonly grown in the county are suited, once these soils are drained. On the poorly drained soils, small grain is likely either to drown out or to grow rank and lodge before it can be harvested. Farm machinery bogs down when the soils are wet.

If drained, these soils are easy to work and to keep in good tilth. Either tile or surface drains can be used if outlets are available. Where the underlying material is silty or sandy, installing tile is difficult because the soil material caves into the trenches. Backfilling trenches with organic material or surface soil material helps to prevent silty and sandy material from flowing into and plugging the tile.

The selection of crops depends on how well the soils are drained. Most crops benefit from applications of fertilizer. Plowing under green-manure crops and the residue of other crops adds organic matter and improves the chance of getting a good stand of plants.

Capability unit IIw–7 (3b)

This unit consists of gently sloping, somewhat poorly drained soils of the Locke, Matherton, and Richter series. These soils have a moderately coarse textured to moderately fine textured subsoil. The Matherton soil is underlain with layers of sand and gravel, and the other soils are underlain with moderately coarse textured to coarse textured material.

Fertility is moderate to moderately high. The available water capacity is moderate to moderately high; the moisture supply is usually adequate for optimum growth of plants. Permeability is moderate to moderately slow. Water runs off slowly and ponds in depressions. The water table is high in spring and after rain in other seasons.

After these soils have been drained and have dried out, they are easy to work and to keep in good tilth and can be used for most of the common crops. The selection of crops depends on the effectiveness of drainage. Installing a complete drainage system is difficult because of the gently sloping relief, but random tile and surface drains are effective in many areas, if the outlets are adequate. In some areas the soil material is unstable, and ditches and trenches are likely to cave in. Backfilling trenches helps to prevent silty and sandy material from flowing into and plugging the tile drains.

Most crops benefit from applications of lime and fertilizer. Plowing under green-manure crops and the residue of other crops adds organic matter and improves the chance of getting a good stand of plants.

Capability unit IIw–8 (3/2b, 3/1c, 3/2c)

This unit consists of level to gently sloping, poorly drained and somewhat poorly drained soils of the Belding, Berville, Breckenridge, Macomb, Metamora, and Munuscong series. These soils have a moderately coarse textured to moderately fine textured subsoil and medium-textured to fine-textured underlying material.

Permeability ranges from slow to moderately rapid. Runoff is very slow to slow, and water ponds in depressions. The water table is high in spring unless lowered

by artificial drainage. The Berville and Macomb soils are moderately high to high in fertility, and the rest of the soils are moderate. The Berville soil is moderately high to high in available water capacity, and the rest of the soils are moderate.

Once these soils have been drained artificially, most of the common crops, including forage crops, can be grown. The selection of crops depends on how effective the drainage is. The excess water can be removed by means of tile drains and surface drains. Only random tile and ditches are feasible where the topography is undulating. The depth to and spacing of tile depend on the depth to the finer textured underlying material. Sand pockets in some areas cause trenches to cave in. Installation of tile is easiest when the soils are dry.

Frost damages crops in low areas in some years.

Capability unit IIw–10 (M/3c)

This unit consists of Linwood muck, a very dark colored, very poorly drained, organic soil that is underlain with sandy loam to silty clay loam at a depth of 12 to 42 inches.

Fertility is low. The available water capacity is high. Permeability is rapid in the organic upper part of the profile and moderate to moderately slow in the underlying mineral material. The water table is at or near the surface part of the year, unless lowered by artificial drainage. Flooding by runoff from higher areas is a hazard. Farm machinery bogs down when the soil is wet, and all farming operations are delayed.

Truck crops, lawn sod, and field crops can be grown on this soil if the water table is lowered, if soil blowing is controlled, and if the crops can be protected from frost and fire. Tile drains and open ditches can be used to lower the water table. The depth to and spacing of tile depend upon the thickness of the organic material. If the tile are in the substratum, they must be closer together than if they are in the organic material. If the water table is lowered too much, the organic material is likely to settle; consequently, careful control of drainage is necessary.

Wind can cause severe damage to this soil. It removes soil material and young crops, and the blowing soil damages growing crops and fills up drainage ditches. Blowing can be checked by controlling the water table, irrigating, stripcropping, planting buffer strips of grain 2 to 3 feet apart, and establishing windbreaks.

Forage crops can be grown where this soil is not drained well enough to be suitable for other crops. Grazing should be restricted during periods of wet weather.

Capability unit IIs–2 (3a, 3/2a)

This unit consists of level and nearly level, well drained and moderately well drained soils of the Alcona, Dryden, Fox, Lapeer, McBride, Owosso, and Ubly series. Most of these soils have a moderately coarse textured or medium-textured subsoil and medium-textured to coarse-textured underlying material.

The available water capacity is moderate; the moisture supply is not adequate to carry crops through a drought. Runoff is slow. Fertility is moderate. Permeability of the Owosso soil is moderately rapid in the upper layers and moderately slow in the lower layers; in the other soils of the unit, permeability is moderate. All the soils can be tilled over a wide range of moisture content. They warm up and are ready for tillage early in spring, and they dry out quickly after rain. They are not likely to crust if tillage is kept to a minimum and organic material is plowed under.

All the common crops, including grasses and legumes, are suited to these soils. Corn, oats, wheat, and hay are grown extensively. Conserving moisture, maintaining the fertility and the organic-matter content, and controlling soil blowing are the main management needs. Plowing under manure and crop residues improves tilth and increases the capacity to absorb water. Winter cover crops help to control blowing and also provide organic matter. Most crops, and especially legumes, benefit from applications of lime.

Capability unit IIIe–3 (1a, 1.5a)

This unit consists of gently sloping, well drained and moderately well drained, moderately eroded soils of the Morley and St. Clair series. Both the subsoil and the underlying material of these soils are fine textured to moderately fine textured.

Fertility is moderately high, but as a result of erosion, tilth and workability are poor. Permeability is moderately slow to very slow. The available water capacity is high, but because of the poor tilth of the surface layer, water runs off rapidly and only a little is absorbed and stored. These soils puddle and then dry out hard and cloddy if cultivated intensively. The surface crusts, and the crust hinders the germination of seeds. In dry summers stands of plants are uneven. Depressions and drainageways dry out slowly in spring, and in some years the excessive wetness hinders and delays planting and harvesting.

Small grain, hay, and corn are the main crops. The hazard of further erosion and the poor tilth resulting from past erosion are the main limitations. Limiting the number of years of row crops in the cropping system reduces the erosion hazard. Minimum tillage and plowing under green-manure crops and the residues of other crops improve the tilth and thereby help to limit runoff and control erosion. Terracing and contour stripcropping, which would help to control erosion, are difficult because of the short, complex slopes.

Capability unit IIIe–4 (1a, 1.5a)

This unit consists of well drained and moderately well drained, sloping soils of the Morley and St. Clair series. Two of these soils are moderately eroded, and the other one is uneroded or only slightly eroded. Both the subsoil and the underlying material are moderately fine textured to fine textured.

Fertility is moderately high. The available water capacity is high, but runoff is rapid and much of the rainfall is not absorbed, so crops are likely to lack sufficient moisture in periods of dry weather. The organic-matter content is low. The moderately eroded soils have poor tilth, and they lose more water through runoff than the uneroded soil. All the soils puddle if worked when wet. The surface crusts, especially that of the moderately eroded soils, and the crust hinders germination of seeds and results in uneven stands of plants. A few spots are wet.

Corn, small grain, and hay are suitable crops. Controlling erosion, improving tilth, increasing the organic-matter content, and maintaining fertility are the main management needs. A cropping system that consists largely of close-growing crops helps to control erosion. Terracing and contour stripcropping, which would also help to control erosion, are difficult in some areas because of short, complex slopes. Even where contour farming is possible, growing row crops for more than 2 years in succession results in excessive runoff and contributes to the erosion hazard.

Capability unit IIIe–5 (2.5a)

This unit consists of well drained and moderately well drained, sloping soils of the Marlette, Miami, and Sisson series. These soils have a medium-textured to moderately fine textured subsoil and moderately coarse textured to medium-textured underlying material. Three of the six soils are moderately eroded, and the other three are uneroded or only slightly eroded.

Fertility is high. The available water capacity is high to moderately high, permeability is moderate to moderately slow, and runoff is rapid where intensive farming is practiced. The uneroded or only slightly eroded soils have good tilth and are easy to work. The moderately eroded ones have poorer tilth; they crust readily on drying, and they absorb less water than the uneroded soils and lose more through runoff.

The common cultivated crops and forage crops can be grown on these soils if erosion is controlled and moisture is conserved. Maintenance of fertility and preservation of tilth are other management needs. A cropping system that consists largely of close-growing crops helps to reduce runoff and control erosion. Minimum tillage reduces the risk of erosion and also promotes good tilth. Because the slopes are short and complex in some areas, terracing and stripcropping, which would help to control erosion, are difficult. Plowing under large amounts of manure and green-manure crops improves tilth and fertility. The moderately eroded soils particularly need these additions of organic matter.

Capability unit IIIe–6 (3a, 3/2a)

This unit consists of well drained and moderately well drained, sloping soils of the Alcona, Fox, Lapeer, McBride, and Owosso series. These soils have a medium-textured to moderately coarse textured subsoil and coarse-textured to medium-textured underlying material. Five of the nine units are moderately eroded; the rest are uneroded or only slightly eroded.

The available water capacity is moderate. Because of the slope, a considerable amount of water runs off and is not absorbed. Permeability is moderately rapid in the upper layers of the Owosso soils and moderately slow in the underlying material. In the rest of the soils, permeability is moderate. All of these soils are moderately fertile, but those that are moderately eroded are less fertile, contain less organic matter, and lose more water through runoff than the uneroded soils.

The common cultivated crops can be grown on these soils if erosion is controlled and moisture is conserved. Minimum tillage and the use of crop residues and cover crops reduce runoff and help to control erosion. Grassed waterways prevent gullying. Where the slopes are long and straight, terracing and stripcropping for control of erosion are practical. Where the slopes are short and complex, runoff can be checked and erosion controlled through the use of a cropping system that consists largely of close-growing crops.

Capability unit IIIe–9 (4a, 4/2a)

This unit consists of well drained and moderately well drained, sloping soils of the Boyer, Mancelona, Menominee, Montcalm, Oshtemo, and Spinks series. Most of these soils are moderately coarse textured to coarse textured. The Menominee soil is underlain with medium-textured to moderately fine textured material, and the Mancelona soil with medium-textured to fine-textured material. The Mancelona soil is moderately eroded; all the others are uneroded or only slightly eroded.

The available water capacity is moderately low; a shortage of moisture exists during the dry summer months. Permeability generally is rapid or moderately rapid, but it is moderately slow in the lower part of the Menominee and Mancelona soils. The moderately eroded Mancelona soil is lower in organic-matter content than the others and consequently has more tendency to be droughty. All the soils in the unit warm up and are ready for planting early in spring. Tillage is easy, but the soils erode readily if cultivated intensively, the Spinks and Montcalm soils more readily than the others.

The soils in this unit are suited to all the common crops. Corn, small grain, and alfalfa are grown, and also some soybeans. The erosion hazard and the shortage of moisture are the main limitations. Water runs off rapidly if crops are planted up and down the slopes, and the runoff causes both erosion and loss of moisture. Shallow-rooted crops do not get enough moisture in dry years. Small grains ordinarily mature early, while the moisture supply is still adequate. Soil blowing is a hazard if large areas are tilled.

Minimum tillage and stubble mulching help to control erosion. Stripcropping for the control of erosion is difficult or impractical where the slopes are not continuous, and maintaining grass cover in waterways is difficult because of the coarse texture of the soils. Plowing under crop residues, green-manure crops, and barnyard manure increases the organic-matter content and thus improves the available water capacity and reduces the hazard of erosion. Heavy fertilization is not profitable if the moisture supply is not adequate to bring crops to maturity.

Capability unit IIIw–1 (0b, 0c)

This unit consists of nearly level and gently sloping, poorly drained and somewhat poorly drained, dark-colored soils of the Paulding and Roselms series. These soils have a fine-textured subsoil and fine-textured underlying material.

These soils are fertile, and they hold enough available water to meet the needs of crops. They warm up slowly in spring. The water table is near the surface part of the year. Permeability is very slow. The organic-matter content varies.

Crops can be grown on these soils if the excess water is removed by artificial drainage. A combination of surface and subsurface drains is needed. Special blinding material facilitates the movement of water into tile drains.

Supplying organic matter and maintaining good tilth are other management needs. These needs can be met by minimum tillage and the incorporation of large amounts of crop residues.

Forage crops can be grown if species that tolerate wetness are selected. Pastures should not be grazed in wet weather, because the soils tend to puddle.

Capability unit IIIw-2 (1b)

This unit consists of level to gently sloping, somewhat poorly drained soils of the Nappanee series. These soils have a fine-textured subsoil and fine-textured underlying material. One soil in the unit is moderately eroded.

The available moisture capacity is high. Fertility is moderately high to high, and the organic-matter content is moderate to high. Permeability is very slow, and water stands on the surface in level areas and depressions for long periods of time. The water table is seasonally near the surface unless lowered by artificial drainage. The clayey subsoil and the high water table restrict the growth of plant roots. When the soils are wet, farm machinery bogs down readily and all farming operations are difficult. The gently sloping soils have slightly better surface drainage than the level soils, and they are subject to erosion.

These soils are well suited to most of the common crops if artificially drained. Tile drains, surface drains, and bedding systems are needed. Unless the excess water is removed from the surface and from within the soils, planting has to be delayed until so late that crops do not have time to mature.

Tilling when the soils are wet is likely to damage structure and tilth. Fall plowing, if the moisture content is favorable, is less likely to damage structure than spring plowing, and it makes earlier planting possible. Plowing under organic material increases the capacity of the soils to absorb water, and it also makes drainage more effective by improving permeability. Frost is a hazard to crops, especially in the lowest areas. Small grain is likely to grow rank and to lodge, because of the moderate to high organic-matter content.

Capability unit IIIw-5 (4b)

This unit consists of level to gently sloping, somewhat poorly drained soils of the Brady, Fabius, Tedrow, and Wasepi series. These soils have a moderately coarse textured subsoil. The Tedrow soils are underlain with sand, and the others with sand and gravel.

All the soils in this unit have a seasonal high water table, but they dry out quickly and tend to be droughty if drained artificially. Permeability is rapid if the water table is lowered. Fertility is low to moderate, and the organic-matter content is low.

These soils are suited to the common crops but are limited by excessive wetness at some times and a shortage of moisture at other times and also by the low to moderate fertility. Small grain, which matures early while the supply of moisture is still adequate, is better suited than corn.

Tile drains or surface drains are needed to remove excess water so that crops can be planted early in spring. Installing tile is easier in dry weather than in wet weather; when the soils are wet, trenches and ditches are likely to cave in. Where the topography is gently sloping, only random tile and surface drains are practical. Some areas lack outlets for drainage.

Frequent light applications of fertilizer are more effective than a single heavy application, because some of the fertilizer is lost through leaching. Soil blowing is a hazard if large areas are cultivated.

Capability unit IIIw-6 (4c)

This unit consists of poorly drained, level soils of the Gilford and Mussey series. These soils have a moderately coarse textured to moderately fine textured subsoil and coarse-textured underlying material.

These soils have a high water table in spring. They are moderately rapidly permeable and tend to be droughty if the water table is lowered by artificial drainage. The available water capacity is low to moderate. Runoff is very slow, and water ponds in depressions and on flats. Fertility is moderate to low.

Corn, small grain, and hay are the common crops in areas that are adequately drained. Pasture and water-tolerant forage crops can be grown in areas not drained.

Tile drains and open ditches are needed to remove excess water. Installing tile and digging ditches are easier in dry weather than in wet weather; when the soils are wet, trenches and ditches are likely to cave in.

Applications of fertilizer and organic material improve productivity. Minimum tillage reduces the risk of soil blowing.

Capability unit IIIw-7 (4/1b, 4/1c)

This unit consists of nearly level and gently sloping, somewhat poorly drained and poorly drained soils of the Allendale and Pinconning series. These are coarse textured or moderately coarse textured soils underlain at a depth of 18 to 42 inches with fine-textured material.

These soils have a high water table in spring and are saturated after rain in other seasons because of their slowly to very slowly permeable underlying material. If drained artificially they dry out quickly and tend to be droughty. The upper layers are rapidly permeable. The available water capacity is moderately low. Runoff is slow, and water ponds in depressions in rainy weather. Fertility is low.

These soils are suited to the common crops but are limited by excess water at some times and a shortage of moisture at other times and also by the low fertility. Small grain, which matures early while the supply of moisture is still adequate, is better suited than corn.

Tile drains and surface drains are needed to remove excess water. Installing tile and digging ditches are easier in dry weather than in wet weather; when the soils are wet, trenches and ditches are likely to cave in. The depth to and the spacing of tile depend on the depth to the fine-textured layers. Diversions to intercept water that runs off higher areas are beneficial. Some areas lack outlets for drainage.

Heavy applications of fertilizer are not profitable if crops lack the moisture needed to bring them to maturity. Soil blowing is a hazard if large areas are cultivated; it can be controlled by minimum tillage, stripcropping, and the use of windbreaks. Plowing under crop residues and green-manure crops improves tilth and increases the water-absorbing capacity.

Capability unit IIIw-9 (4/2b)

This unit consists of Iosco loamy sand, 0 to 2 percent slopes, a nearly level, somewhat poorly drained, coarse-textured soil that has medium-textured to moderately fine textured material at a depth of 18 to 42 inches.

This soil has a high water table in spring and is saturated after rain in other seasons because of its moderately slowly permeable underlying material. If drained artificially the soil dries out quickly and tends to be droughty. The upper layers are rapidly permeable. The available water capacity is moderately low. Runoff is slow, and water ponds in depressions in rainy weather. Fertility is low.

This soil is suited to the common crops but is limited by excess water at some times and a shortage of moisture at other times and also by low fertility. Small grain, which matures early while the supply of moisture is still adequate, is better suited than corn.

Tile drains and open ditches are needed to remove excess water. Installing tile and digging ditches are easier in dry weather than in wet weather; when the soil is wet, trenches and ditches are likely to cave in. Diversions to intercept runoff from adjacent higher areas are beneficial. Some areas lack outlets for drainage.

Heavy applications of fertilizer are not profitable in dry years when crops fail to mature because of lack of sufficient moisture. Soil blowing is a hazard if large areas are cultivated; it can be controlled by minimum tillage, stripcropping, and the use of windbreaks. Plowing under crop residues and green-manure crops improves tilth and increases the water-absorbing capacity.

Capability unit IIIw-10 (4/2c)

This unit consists of Brevort loamy sand, a level, poorly drained, coarse-textured soil that has moderately fine textured material at a depth of 18 to 42 inches.

This soil has a high water table in spring and is saturated after rain in other seasons because of the moderately slow permeability of its underlying material. If drained artificially the soil dries out quickly and is droughty in long periods of dry weather. If not drained it dries out so slowly that planting and harvesting may have to be delayed. The upper layers are rapidly permeable. The available water capacity is moderately low. Runoff is very slow or ponded. Fertility is moderately low.

Drained areas of this soil are used for crops and pasture. Small grain, which matures early while the supply of moisture is still adequate, is better suited than crops that mature late in summer. Many areas are still in woodland.

Excess water can be removed by means of tile drains and open ditches. Installing tile and digging ditches are easier in dry weather than in wet weather because ditches and trenches are likely to cave in when the soil is wet. The depth to and the spacing of tile depend on the depth to the moderately fine textured underlying material. Diversions to intercept runoff from adjacent higher soils are beneficial. Many areas lack outlets for drainage.

Minimum tillage, the addition of organic matter, and the application of fertilizer improve productivity and increase the available water capacity. Crops are damaged by frost in some years.

Capability unit IIIw-12 (L-2c)

This unit consists of somewhat poorly drained and poorly drained, level soils of the Ceresco, Cohoctah, and Sloan series. These soils are on bottom lands and are subject to flooding. They formed in stratified water-deposited material. They vary widely in texture but are mainly moderately coarse textured to medium textured.

Fertility is moderate to high, the available water capacity is moderate to high, and permeability is moderate to moderately rapid.

The use of these soils for crops is limited by the flood hazard, a high water table, and a frost hazard. Some areas dry out enough to be used for pasture. Many areas are cut by meandering streams into tracts too small for farming.

Capability unit IIIw-14 (L-4c)

This unit consists of somewhat poorly drained and poorly drained, level soils of the Algansee and Glendora series. These soils are on bottom lands and are subject to flooding. They formed in material deposited by floodwater. They have coarse-textured underlying material.

Fertility is low, permeability is rapid, and the available water capacity is low. The water table is at or near the surface in wet weather.

Woodland and pasture are suitable uses for these soils. The flood hazard, a frost hazard, and excessive wetness limit their use for cultivated crops. Most areas cannot be draind by tile and ditches, because of the unstable nature of the sandy soil material.

Capability unit IIIw-15 (Mc, M/1c)

This unit consists of level, very poorly drained, dark-colored, organic soils of the Carlisle, Houghton, Lupton, and Willette series. These soils consist of the remains of woody and fibrous plants. In the Willette soil the organic material is 12 to 42 inches thick and is underlain with clayey material. In the other soils the organic material is more than 42 inches thick.

Fertility is low, and the reaction ranges from strongly acid to alkaline. The available water capacity is high. The Willette soil has very slowly permeable underlying material; the rest of the soils in the unit are rapidly permeable. Runoff is slow to ponded. Farm machinery bogs down when these soils are wet, and all farming operations are hampered unless the water table is lowered artificially.

These soils cannot be cultivated intensively unless they are drained artificially. The water table needs to be lowered enough that the roots of crops will have enough room to grow but not so much as to cause the organic soil material to settle. The water table can be kept at a higher level in areas used for grassland farming than in areas where specialty crops are grown, and at an even higher level where no crop is being grown.

Other limitations, in addition to excessive wetness, are low fertility, a hazard of soil blowing, a frost hazard, and a fire hazard. Fertilizer containing phosphorus, potassium, and micronutrients (including manganese, boron, copper, molybdenum, and zinc) is needed. Blowing causes loss of soil material and of newly planted seed, injures growing crops, and fills drainage ditches with drifting soil material. Blowing can be checked by con-

trolling the water table, compacting the surface, irrigating, stripcropping, planting buffer strips of grain 2 to 3 feet apart, and establishing windbreaks. Sprinkler irrigation reduces the hazard of soil blowing and also provides protection against frost. Other ways of preventing frost damage are planting frost-resistant varieties, planting where air drainage is good, and fertilizing heavily with potassium.

Capability unit IIIs–3 (4a, 4/2a)

This unit consists of nearly level, well drained and moderately well drained soils of the Boyer, Menominee, Montcalm, Oshtemo, and Spinks series. The Boyer, Montcalm, Oshtemo, and Spinks soils have a moderately coarse textured subsoil and coarse textured underlying material. The Menominee soil is coarse textured to a depth of 18 to 42 inches and medium textured to moderately fine textured below that depth.

Fertility is low to moderately low, and the organic-matter content is low. The available water capacity is moderately low; the supply is generally not adequate for optimum growth of crops through the summer. The Menominee soil, because of its moderately fine textured underlying material, has slightly higher available water capacity than the rest of the soils. Permeability, for the most part, is rapid to moderately rapid, but the lower layers of the Menominee soil are moderately slowly permeable.

Corn, small grain, and hay are the major crops. Drought-resistant and early-maturing crops are to be preferred. Deep-rooted forage plants are well suited.

Water erosion is not a significant hazard, but soil blowing can do serious damage where intensive farming is practiced. Minimum tillage, stripcropping, and the use of windbreaks help to check blowing. Fertilizer is needed, especially nitrogen, but heavy applications are not profitable in dry years when crops fail because of lack of adequate moisture. Plowing under crop residues and green-manure crops increases the organic-matter content and also helps to raise fertility.

Capability unit IIIs–4 (4a, 4/2a)

This unit consists of level to gently sloping, well drained and moderately well drained soils of the Boyer, Mancelona, Menominee, Montcalm, Oshtemo, and Spinks series. All except the Mancelona and Menominee soils have a moderately coarse textured subsoil and coarse textured underlying material. The Menominee soil is coarse textured to a depth of 18 to 42 inches and medium textured to moderately fine textured below that depth. The Mancelona soil is coarse textured to a depth of 42 to 66 inches and medium textured to fine textured below that depth.

Fertility is low to moderately low. The available water capacity is moderately low; normally the soils are filled to their capacity at the start of the growing season, but the supply is not adequate to maintain optimum growth of crops through the growing season unless enough rain falls to replace the water used. The Spinks soil is more droughty than the other soils in the unit. Permeability generally is moderately rapid to rapid, but the Mancelona and Menominee soils have medium-textured to moderately fine textured layers that restrict the downward movement of water and help to keep the upper layers moist. Runoff is slow to medium. All the soils are easy to work and can be cultivated throughout a wide range of moisture content without clodding or crusting.

Most of the common crops can be grown on these soils. Those that mature early or are drought resistant are to be preferred. Corn, small grain, and hay are the principal crops grown.

Water erosion is not a significant hazard, but cultivated areas need protection against soil blowing. Minimum tillage, stripcropping, and the use of windbreaks are among the measures that can be used to check blowing. Plowing under crop residues, green-manure crops, and barnyard manure increases the organic-matter content, raises fertility, and improves the capacity of the soils to absorb moisture. Fertilizer is needed, but heavy applications are not profitable in dry years when crops fail to mature because of lack of adequate moisture.

Capability unit IVe–4 (1.5a, 2.5a, 3a)

This unit consists of well-drained, moderately steep and hilly soils of the Lapeer, Marlette, McBride, Miami, and Morley series. The Morley soil has a fine textured subsoil and moderately fine textured underlying material. The rest of the soils in the unit have a medium-textured or moderately fine textured subsoil and medium-textured or moderately coarse textured underlying material. Five of the seven soils in the unit are moderately eroded; the other two are uneroded or only slightly eroded.

Fertility is moderate to high. Permeability is moderate to moderately slow. The available water capacity is moderate to high, but runoff is rapid and only a little water is absorbed and stored. The erosion hazard is serious in cultivated areas. The moderately eroded soils are low in organic-matter content and are likely to crust at the surface; they lose more water through runoff than the uneroded soils and are more susceptible to erosion.

Small grain and hay are the crops most commonly grown. The soils are too steep to be cropped intensively. Growing row crops in successive years and planting them up and down the slope intensify the erosion hazard. Minimum tillage, stripcropping, and long rotations help to check runoff and reduce the erosion hazard. Plowing under large amounts of organic material improves the capacity of the soils to absorb water. Grassed waterways help to remove runoff safely. Where the slopes are too short and too complex for terracing or stripcropping, runoff and erosion can be controlled by using a cropping system that consists largely of close-growing crops.

Capability unit IVe–5 (1.5a, 2.5a)

This unit consists of sloping, well drained and moderately well drained, severely eroded soils of the Marlette, Miami, and Morley series. These soils have a moderately fine textured to fine textured subsoil and medium-textured to moderately fine textured underlying material.

The available water capacity is high, but runoff is rapid and only a little water is absorbed and stored. Permeability is moderately slow. The organic-matter content is very low, and tilth is poor. Tillage is difficult where the moderately fine textured subsoil is at the surface. The hazard of further erosion is very severe.

Forage crops are better suited to these soils than row crops. The effects of erosion and the hazard of further erosion are very severe limitations for farming. Permanent vegetation or a rotation that consists largely of hay crops helps to control erosion. Increasing the organic-matter content and thus improving tilth is a major need.

Capability unit IVe–6 (3a)

This unit consists of sloping, well drained and moderately well drained, severely eroded soils of the Lapeer and McBride series. These soils have a medium-textured subsoil and moderately coarse textured underlying material.

Erosion has removed most, and in some places all, of the original surface layer and has reduced fertility and impaired tilth severely. The present surface layer is in poor tilth; it absorbs water slowly and crusts as it dries. In many places it contains gravel and cobblestones. Seeds do not germinate evenly, and stands of plants are poor in many areas. Permeability is moderate. Runoff is rapid, and the hazard of further erosion is very severe. The supply of available water is not sufficient for optimum growth of crops during prolonged periods of dry weather.

These soils are better suited to close-growing crops, such as small grain, grasses, and legumes, than to corn or other row crops. The effects of erosion and the hazard of further erosion are very severe limitations for farming. Maintaining a permanent cover of grass, by seeding and by regulation of mowing and grazing, is one suitable system of management.

Capability unit IVe–9 (4a, 4/2a)

This unit consists of well-drained, moderately steep and hilly soils of the Boyer, Menominee, Montcalm, and Spinks series. All these soils except the Menominee soil have a moderately coarse textured subsoil. Menominee soils are coarse textured to a depth of 18 to 42 inches and medium textured to moderately fine textured below. Boyer soils are underlain with stratified sand and gravel, and the Montcalm and Spinks soils with sand.

Fertility is low to moderately low. Runoff is rapid, permeability generally is rapid to moderately rapid, and the available water capacity is moderately low; consequently, there is a shortage of moisture for crops in summer. These soils are easy to till, but in some places the slopes are steep enough to limit the use of farm machinery. The hazard of water erosion is very severe, and soil blowing becomes a hazard if large acreages are tilled.

The use of these soils for crops is severely limited by the hazard of erosion and the shortage of moisture. Small grain, which matures early while the moisture supply is still adequate, is better suited than other crops. Shallow-rooted crops do not attain their optimum growth in dry years.

Minimum tillage, stubble mulching, and stripcropping help to reduce runoff and control erosion. Where the slopes are not continuous and these practices are impractical, a cover of grass should be maintained. Overgrazing of such areas allows gullying. Fertilizer and organic matter are needed. In dry years when crops fail to mature because of lack of moisture, heavy applications of fertilizer may not be profitable.

Capability unit IVw–1 (Mc–a)

This unit consists of Spalding-Greenwood peats, a complex of level, very poorly drained, dark-colored, organic soils more than 42 inches thick.

These soils are very severely limited for the production of crops, grass, or trees by a high water table and a very strongly acid reaction. In their natural state, they are covered with leatherleaf and sphagnum moss and are suitable mainly for wildlife habitat. Blueberries are grown commercially on small areas, and some peat moss is cut for marketing.

Capability unit IVw–2 (5b)

This unit consists of nearly level and gently sloping, somewhat poorly drained, coarse-textured soils of the Au Gres series. One of the two soils has coarse-textured underlying material, and the other has medium-textured to fine-textured underlying material.

These soils are excessively wet in spring because of a seasonal high water table. They become droughty if the water table is lowered by artificial drainage. Permeability is restricted in the soil that has the finer textured underlying material. Runoff is slow, and water ponds in depressions. The available water capacity is low, and fertility is low. If drained the soils are easy to till.

The use of these soils for crops is very severely limited by excessive wetness, low fertility, low available water capacity, and a hazard of soil blowing.

Artificial drainage is difficult because the soil material is sandy and trenches and ditches are likely to cave in. Tile trenches need to be backfilled with porous material, such as straw, topsoil, or grass, to keep the sandy material from flowing into and plugging the drains. Since the soils tend to become droughty, control of drainage is needed to keep the moisture content at a level favorable for crops.

Maintaining fertility and the organic-matter content is difficult because of the sandy texture. Applications of lime benefit some crops. Applications of fertilizer are beneficial if drainage is adequate, but heavy applications may not be profitable in dry years when crops fail to mature because of lack of adequate moisture. Soil blowing can be checked by stripcropping and the use of windbreaks.

Capability unit IVw–4 (5c)

This unit consists of level, poorly drained soils of the Granby series. These soils have coarse-textured underlying material.

The water table is at or near the surface unless lowered by artificial drainage. Permeability is rapid after drainage is improved. The available water capacity is low. Fertility is low, and the organic-matter content is moderately high. Most of the acreage is in depressions, where frost is a hazard.

These soils are better suited to forage crops than to cultivated crops, and little of the acreage is cultivated. Excessive wetness, low fertility, and the frost hazard are severe limitations. A few areas are used under intensive management for the production of truck crops. The selection of forage crops depends on the degree of wetness.

Capability unit IVw–5 (M/4c)

This unit consists of level, very poorly drained, organic soils of the Adrian and Tawas series. The organic layers in these soils range in thickness from 12 to 42 inches and are underlain with sand.

Fertility is low. The water table is high unless lowered by artificial drainage. The available water capacity is high, permeability is rapid, and runoff is very slow to ponded. Unless the water table is lowered, farm machinery bogs down readily and all farming operations are hampered. If the water table is lowered too much, however, the soils become droughty and susceptible to blowing.

Truck crops and sod can be grown on these soils if the water level is controlled and frost damage is prevented.

Through a system that includes dams and dikes, subirrigation facilities, and both tile drains and open drains, the water table can be kept at a level that permits optimum growth of crops but does not result in droughtiness and increased susceptibility to blowing nor cause the organic soil material to settle. Grasses tolerate a higher water table than specialty crops. When no crop is being grown, the water table can be kept at a still higher level, as a precaution against settling. The hazard of frost damage can be reduced by selecting frost-resistant varieties, by planting where air drainage is good, and by fertilizing heavily with potassium.

Low fertility, the hazard of soil blowing, and the hazard of fire are other significant limitations of these soils. Fertilizer is needed to make up for deficiencies in phosphorus and potassium and in micronutrients, including manganese, boron, copper, molybdenum, and zinc. Blowing removes soil material and newly planted seed, injures growing crops, and fills drainage ditches with drifting soil material. It can be controlled by compacting the surface, irrigating, stripcropping, using windbreaks; growing grain in buffer strips 2 to 3 feet apart, and varying the level of the water table. Windbreaks, in addition to checking blowing, offer nesting sites and cover for wildlife. Sprinkler irrigation, a common practice, reduces the hazard of soil blowing and helps protect crops against frost damage, as well as providing moisture for crops as needed.

Capability unit IVw–6 (M/mc)

This unit consists of level, very poorly drained, very dark colored, organic soils of the Edwards and Warners series. These soils are underlain with marl, the Edwards soil at a depth of 12 to 42 inches and the Warners soil at a depth of less than 12 inches.

Permeability varies because of differences in the composition of the underlying marl. The available water capacity is high. The water table is at the surface at least part of the year unless lowered by artificial drainage.

The suitability of these soils for cultivated crops depends on the depth to marl, the feasibility of drainage, and the severity of the frost hazard. Each area has to be studied individually. Most areas of the Warners soil cannot be drained, because the marl is so near the surface and drainage outlets are lacking. The marl and the alkaline reaction restrict the availability of plant nutrients. Forage crops that tolerate wetness do moderately well; the kinds to be grown depend on the degree of wetness. Grazing should not be allowed when the soils are wet.

Capability unit IVs–4 (5a, L–4a)

This unit is made up of well drained and moderately well drained, level to gently sloping or undulating soils of the Abscota and Chelsea series. These soils are coarse textured to a depth of 42 inches or more. The Abscota soil is on bottom lands and is flooded occasionally.

Fertility is low. Very little water runs off, but permeability is rapid, and the available water capacity is low; consequently, the moisture supply in summer is not usually adequate for optimum growth of crops.

A few areas of these soils are farmed; hay and oats are the main crops. Low fertility, low available water capacity, a hazard of soil blowing, and a flood hazard are very severe limitations. Crops on these soils show the effects of drought fairly soon. In extremely dry years, corn and other shallow-rooted crops do not mature. Crops that mature early in the season, before the stored water is used up, are suitable. Forage crops grow well early in the season but less well during the dry months of summer.

Lime benefits many crops, especially legumes. Fertilizer is also beneficial, but heavy applications may not be profitable in dry years, because the lack of adequate moisture may prevent crops from maturing. Minimum tillage helps to limit the loss of moisture through evaporation. Blowing is a hazard if the soils are tilled.

Capability unit VIe–2 (1.5a, 2.5a, 3a, 4a)

This unit consists of well-drained, moderately steep and steep soils (fig. 15) of the Boyer, Lapeer, Marlette, McBride, Miami, Montcalm, Morley, and Spinks series. These soils range in texture from coarse to moderately fine. They are slightly eroded to severely eroded.

Fertility ranges from low to high, and the available water capacity from moderately low to high. Runoff is rapid, and the erosion hazard is serious. The severely eroded soils are in poor tilth and crust readily as they dry.

The slope and the hazard of further erosion severely limit the use of these soils for row crops and small grains. The major management need is the maintenance of a vegetative cover for protection against erosion. Pasture and forage crops can be grown, but even these do not grow well on the coarse-textured soils, because of the lack of sufficient moisture in summer. Overgrazing of pastures can cause erosion and gullying. Harvesting forage crops is difficult because the slope hinders the use of farm machinery.

Capability unit VIs–1 (5a)

This unit consists of Chelsea loamy sand, 6 to 12 percent slopes, a well-drained soil that is coarse textured throughout. This soil is slightly eroded.

Fertility is very low. The organic-matter content is low and is quickly depleted by tillage. Permeability is rapid, and the available water capacity is low. The soil dries out quickly and is short of moisture in summer. It is easy to till but erodes readily.

Figure 15.—**Typical soils of capability unit VIe–2. The slope and the severe risk of erosion make these soils unsuitable for row crops and small grain.**

Very low fertility, low available water capacity, and the erosion hazard severely limit the use of this soil for crops or pasture. Shallow-rooted crops are not suitable. Pasture and forage plants grow well early in the season but not during the dry months of summer. Permanent vegetation provides protection against erosion. Trees help to control erosion and also provide wildlife habitat.

Capability unit VIIe–2 (1.5a, 2.5a, 3a, 4a)

This unit consists of well-drained, steep and very steep soils of the Boyer, Lapeer, Marlette, McBride, Miami, Montcalm, Morley, and Spinks series, and one miscellaneous land type, Gullied land, loamy. In texture, these soils range from coarse to fine. They are slightly eroded to severely eroded.

These soils are droughty because water runs off very rapidly and very little is absorbed and stored. The erosion hazard is severe. The soils that are already eroded have poor tilth and are even more susceptible to further erosion.

Keeping these soils in grass or trees helps to check erosion and gullying. Pastures dry up in summer and so furnish only small amounts of forage. Overgrazing of pastures encourages runoff and gullying.

Capability unit VIIs–1 (5a)

This unit consists of one well-drained soil, Chelsea loamy sand, 12 to 18 percent slopes, and one miscellaneous land type, Gullied land, sandy. Both these mapping units are mainly coarse textured.

Fertility is very low. The organic-matter content is low, and it decreases rapidly if the soils are tilled. The available water capacity is low.

These soils are not suited to crops. Pastures dry up quickly in summer and furnish only small amounts of forage. Stones on the surface in some areas interfere with or prevent tillage. The slope restricts the use of farm machinery.

Capability unit VIIIs–1 (Sa)

This unit consists of Borrow pits, Gravel pits, and Made land, none of which is suitable for farming. Some Borrow pits and Gravel pits hold water and have possibilities for recreational use. Most areas of Made land have been used for commercial or residential purposes.

Predicted Yields

Table 2 shows the predicted average yields per acre of the principal crops grown in the county, under prevailing management and under improved management. These predictions are indicative of the relative productivity of the soils of the county.

The figures in columns A represent recorded yields under prevailing management. At this level of management, some legume-grass crops are included in the rotation, but generally little consideration is given to the suitability of the rotation for the soil; lime is applied, but in many places in insufficient amounts and not according to recommendations based on soil tests; some fertilizer is applied; poorly drained soils are cultivated without being drained artificially, and partial crop failures caused by excess water are common; and erosion control and other management practices are not used to the fullest advantage.

TABLE 2.—*Predicted average yields under two levels of management*

Columns A show yields to be expected under management common in the county; columns B show yields that can be obtained under improved management. Dashes indicate that the crop is not suited to the soil or is not ordinarily grown on it]

Soil	Corn (grain)		Corn (silage)		Oats		Wheat		Alfalfa or alfalfa-brome hay	
	A	B	A	B	A	B	A	B	A	B
	Bu.	*Bu.*	*Tons*	*Tons*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*
Abscota loamy sand	50	90	9	16						
Adrian muck	45	85	8	14		65	30	40	2. 2	3. 5
Alcona sandy loam, 0 to 2 percent slopes	45	85	8	14	45	65	30	40	2. 2	3. 5
Alcona sandy loam, 2 to 6 percent slopes	40	80	7	13	40	60	25	35	2. 2	3. 5
Alcona sandy loam, 6 to 12 percent slopes										
Algansee sandy loam	40	65	6	10	35	60	22	45	2. 0	3. 5
Allendale loamy sand, 0 to 2 percent slopes	40	65	6	10	35	60	22	45	2. 0	3. 5
Allendale loamy sand, 2 to 6 percent slopes	25	45	4	7	20	40	16	25	1. 3	2. 1
Au Gres loamy sand, 0 to 6 percent slopes										
Au Gres loamy sand, loamy substratum, 0 to 2 percent slopes	25	45	4	7	20	40	16	25	1. 3	2. 1
Barry loam	50	80	7	14	45	70	25	45	1. 5	3. 5
Belding sandy loam, 0 to 2 percent slopes	50	85	9	14	45	70	30	50	2. 2	4. 0
Belding sandy loam, 2 to 6 percent slopes	50	85	9	14	45	70	30	50	2. 2	4. 0
Belding sandy loam, clay subsoil variant, 0 to 2 percent slopes	50	75	7	13	45	68	25	40	2. 2	3. 5
Belding sandy loam, clay subsoil variant, 2 to 6 percent slopes	50	75	7	13	45	68	25	40	2. 2	3. 5
Berville loam	50	80	7	14	45	70	25	45	1. 5	3. 5
Blount loam, 0 to 2 percent slopes	65	90	12	15	50	80	35	45	2. 2	4. 2
Blount loam, 2 to 6 percent slopes	65	90	12	15	50	80	35	45	2. 2	4. 2
Blount loam, 2 to 6 percent slopes, moderately eroded	55	80	10	13	45	75	33	45	2. 2	3. 8
Borrow pits										
Boyer loamy sand, 0 to 2 percent slopes	35	65	6	11	30	50	25	40	2. 0	3. 0
Boyer loamy sand, 2 to 6 percent slopes	35	65	6	11	30	50	25	40	2. 0	3. 0
Boyer loamy sand, 6 to 12 percent slopes	32	60	5	10	27	45	20	35	2. 0	3. 0
Boyer loamy sand, 12 to 18 percent slopes	30	55	5	9	24	40	18	30	2. 0	3. 0
Boyer loamy sand, 18 to 25 percent slopes										
Boyer loamy sand, 25 to 50 percent slopes										
Boyer sandy loam, 0 to 2 percent slopes	40	70	7	12	32	60	25	40	2. 0	3. 0
Boyer sandy loam, 2 to 6 percent slopes	40	70	7	12	32	60	25	40	2. 0	3. 0
Boyer sandy loam, 6 to 12 percent slopes	35	65	5	11	25	55	20	35	2. 0	3. 0
Boyer sandy loam, 12 to 18 percent slopes	32	60	5	10	25	50	18	30	2. 0	3. 0
Brady loamy sand, 0 to 2 percent slopes	50	80	8	12	45	60	25	40	2. 0	3. 0
Brady loamy sand, 2 to 6 percent slopes	50	80	8	12	45	60	25	40	2. 0	3. 0
Breckenridge sandy loam	50	80	7	14	45	70	25	45	1. 5	3. 5
Brevort loamy sand	25	65	4	10	25	45	15	30	1. 2	2. 2
Brookston loam	60	110	11	18	50	80	30	55	2. 5	5. 0
Capac fine sandy loam, 0 to 2 percent slopes	65	100	12	17	55	80	35	55	2. 7	5. 0
Capac fine sandy loam, 2 to 6 percent slopes	65	100	12	17	55	80	35	55	2. 7	5. 0
Carlisle muck	60	110	11	18						
Celina loam, 0 to 2 percent slopes	55	95	9	16	55	75	35	45	3. 0	4. 5
Celina loam, 2 to 6 percent slopes	55	95	9	16	55	75	35	45	3. 0	4. 5
Celina loam, 2 to 6 percent slopes, moderately eroded	50	90	8	15	50	70	30	40	2. 3	3. 5
Ceresco loam										
Chelsea loamy sand, 0 to 6 percent slopes	25	40	4	7	18	35	13	22	1. 2	2. 0
Chelsea loamy sand, 6 to 12 percent slopes									1. 2	2. 0
Chelsea loamy sand, 12 to 18 percent slopes										
Cohoctah loam										
Colwood loam	50	110	7	18	50	80	30	55	2. 5	5. 0
Conover loam, 0 to 2 percent slopes	60	100	11	17	55	80	35	55	2. 7	5. 0
Conover loam, 2 to 6 percent slopes	60	100	11	17	55	80	35	55	2. 7	5. 0
Del Rey silt loam, 0 to 2 percent slopes	50	90	9	15	50	80	35	45	2. 2	4. 2
Del Rey silt loam, 2 to 6 percent slopes	50	90	9	15	50	80	35	45	2. 2	4. 2
Dryden sandy loam, 0 to 2 percent slopes	45	85	8	14	45	65	30	40	2. 5	4. 0
Dryden sandy loam, 2 to 6 percent slopes	45	85	8	14	45	65	30	40	2. 5	4. 0
Edwards muck	50	90	9	15						
Fabius-Wasepi sandy loams, 0 to 2 percent slopes	50	80	8	12	45	60	25	40	2. 0	3. 0
Fabius-Wasepi sandy loams, 2 to 6 percent slopes	50	80	8	12	45	60	25	40	2. 0	3. 0
Fox sandy loam, 0 to 2 percent slopes	50	85	9	14	45	70	30	40	2. 5	4. 0
Fox sandy loam, 2 to 6 percent slopes	50	85	9	14	45	70	30	40	2. 5	4. 0
Fox sandy loam, 6 to 12 percent slopes, moderately eroded	45	80	8	13	40	65	25	35	2. 2	3. 5
Gilford sandy loam	40	75	6	12	35	50	22	35	1. 8	3. 0
Glendora loam										
Granby loamy sand	25	65	4	10	25	45	15	30	1. 2	2. 2
Granby loam	40	75	6	12	35	50	22	35	1. 8	3. 0
Gravel pits										

TABLE 2.—*Predicted average yields under two levels of management*—Continued

Soil	Corn (grain)		Corn (silage)		Oats		Wheat		Alfalfa or alfalfa-brome hay	
	A	B	A	B	A	B	A	B	A	B
	Bu.	*Bu.*	*Tons*	*Tons*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*
Gullied land, sandy										
Gullied land, loamy										
Houghton muck	60	110	10	18						
Hoytville silt loam	35	90	7	15	40	70	25	40	1. 5	3. 5
Hoytville silty clay loam	35	90	7	15	40	70	25	40	1. 5	3. 5
Iosco loamy sand, 0 to 2 percent slopes	40	65	6	10	35	60	22	45	2. 0	3. 5
Kibbie loam, 0 to 2 percent slopes	55	95	9	16	55	80	35	55	2. 8	5. 0
Kibbie loam, 2 to 6 percent slopes	55	95	9	16	55	80	35	55	2. 8	5. 0
Lapeer sandy loam, 0 to 2 percent slopes	45	85	8	14	45	65	30	40	2. 5	4. 0
Lapeer sandy loam, 2 to 6 percent slopes	45	85	8	14	45	65	30	40	2. 5	4. 0
Lapeer sandy loam, 2 to 6 percent slopes, moderately eroded	45	85	8	14	45	65	30	40	2. 5	4. 0
Lapeer sandy loam, 6 to 12 percent slopes	40	80	7	14	40	60	25	35	2 2	3. 5
Lapeer sandy loam, 6 to 12 percent slopes, moderately eroded	40	80	7	14	40	60	25	35	2. 2	3. 5
Lapeer sandy loam, 6 to 12 percent slopes, severely eroded	35	60	6	10	35	55	20	30	1. 8	3. 0
Lapeer sandy loam, 12 to 18 percent slopes, moderately eroded	35	70	6	12	35	55	20	30	1. 8	3. 0
Lapeer sandy loam, 12 to 18 percent slopes, severely eroded										
Lapeer sandy loam, 18 to 25 percent slopes, moderately eroded										
Lapeer sandy loam, 18 to 25 percent slopes, severely eroded										
Lapeer sandy loam, 25 to 60 percent slopes										
Lenawee silty clay loam	50	100	9	17	45	80	30	55	2. 0	5. 0
Linwood muck	60	90	10	15						
Locke sandy loam, 0 to 2 percent slopes	55	90	9	15	50	70	30	50	2. 2	4. 0
Locke sandy loam, 2 to 6 percent slopes	55	90	9	15	50	70	30	50	2. 2	4. 0
Lupton muck	60	110	11	18						
Macomb sandy loam, 0 to 2 percent slopes	55	90	9	15	50	70	30	50	2. 2	4. 0
Macomb sandy loam, 2 to 6 percent slopes	55	90	9	15	50	70	30	50	2. 2	4. 0
Made land										
Manceiona loamy sand, moderately fine substratum, 0 to 6 percent slopes	35	65	6	11	30	50	25	40	2. 0	3. 0
Manceiona loamy sand, moderately fine substratum, 6 to 12 percent slopes, moderately eroded	32	60	5	10	27	45	20	35	2. 0	3. 0
Marlette sandy loam, 0 to 2 percent slopes	55	95	9	16	55	75	35	45	3. 0	4. 5
Marlette sandy loam, 2 to 6 percent slopes	55	95	9	16	55	75	35	45	3. 0	4. 5
Marlette sandy loam, 2 to 6 percent slopes, moderately eroded	50	90	8	15	50	70	32	40	3. 0	4. 5
Marlette sandy loam, 6 to 12 percent slopes	45	85	7	14	45	70	30	40	3. 0	4. 0
Marlette sandy loam, 6 to 12 percent slopes, moderately eroded	40	75	6	12	40	65	25	35	2. 3	3. 5
Marlette sandy loam, 6 to 12 percent slopes, severely eroded	30	50	4	8	25	50	20	30	2. 0	3. 0
Marlette sandy loam, 12 to 18 percent slopes, moderately eroded	35	70	6	12	35	60	22	33	2. 3	3. 5
Marlette sandy loam, 12 to 18 percent slopes, severely eroded										
Marlette sandy loam, 18 to 25 percent slopes, moderately eroded										
Marlette sandy loam, 25 to 60 percent slopes, moderately eroded										
Matherton loam, 0 to 2 percent slopes	55	90	9	15	50	70	30	50	2. 2	4. 0
Matherton loam, 2 to 6 percent slopes	55	90	9	15	50	70	30	50	2. 2	4. 0
McBride loamy sand, 2 to 6 percent slopes	35	65	6	11	30	50	25	40	2. 0	3. 0
McBride loamy sand, 2 to 6 percent slopes, moderately eroded	35	65	6	11	30	50	25	40	2. 0	3. 0
McBride loamy sand, 6 to 12 percent slopes, moderately eroded	32	60	5	10	27	45	20	35	1. 8	2. 8
McBride sandy loam, 0 to 2 percent slopes	45	85	8	14	45	65	30	40	2. 5	4. 0
McBride sandy loam, 2 to 6 percent slopes	45	85	8	14	45	65	30	40	2. 5	4. 0
McBride sandy loam, 2 to 6 percent slopes, moderately eroded	45	85	8	14	45	65	30	40	2. 5	4. 0
McBride sandy loam, 6 to 12 percent slopes	40	80	7	14	40	60	25	35	2. 2	3. 5
McBride sandy loam, 6 to 12 percent slopes, moderately eroded	40	80	7	14	40	60	25	35	2. 2	3. 5
McBride sandy loam, 6 to 12 percent slopes, severely eroded	35	60	6	10	35	55	20	30	1. 8	3. 0

TABLE 2.—*Predicted average yields under two levels of management*—Continued

Soil	Corn (grain)		Corn (silage)		Oats		Wheat		Alfalfa or alfalfa-brome hay	
	A	B	A	B	A	B	A	B	A	B
	Bu.	*Bu.*	*Tons*	*Tons*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*
McBride sandy loam, 12 to 18 percent slopes	35	70	6	12	35	55	20	30	1. 8	3. 0
McBride sandy loam, 12 to 18 percent slopes, moderately eroded	35	70	6	12	35	55	20	30	1. 8	3. 0
McBride sandy loam, 12 to 18 percent slopes, severely eroded										
McBride sandy loam, 18 to 25 percent slopes, moderately eroded										
McBride sandy loam, 25 to 60 percent slopes										
Menominee loamy sand, 0 to 2 percent slopes	30	65	5	10	35	50	21	30	1. 3	2. 0
Menominee loamy sand, 2 to 6 percent slopes	30	65	5	10	35	50	21	30	1. 3	2. 0
Menominee loamy sand, 6 to 12 percent slopes	27	60	4	10	18	32	12	25	1. 3	2. 0
Menominee loamy sand, 12 to 18 percent slopes	24	55	4	9	15	28	10	23	1. 3	2. 0
Metamora sandy loam, 0 to 2 percent slopes	50	85	9	14	45	70	30	50	2. 2	4. 0
Metamora sandy loam, 2 to 6 percent slopes	50	85	9	14	45	70	30	50	2. 2	4. 0
Miami loam, 2 to 6 percent slopes	55	95	9	16	55	75	35	45	3. 0	4. 5
Miami loam, 2 to 6 percent slopes, moderately eroded	50	90	8	15	50	70	32	40	3. 0	4. 0
Miami loam, 6 to 12 percent slopes	45	85	7	14	45	70	30	40	3. 0	4. 0
Miami loam, 6 to 12 percent slopes, moderately eroded	40	75	6	12	40	65	25	35	2. 3	3. 5
Miami loam, 12 to 18 percent slopes	35	70	6	12	35	60	22	33	2. 3	3. 5
Miami loam, 12 to 18 percent slopes, moderately eroded	30	60	5	10	32	55	20	30	2. 3	3. 5
Miami loam, 18 to 25 percent slopes										
Miami loam, 18 to 25 percent slopes, moderately eroded										
Miami loam, 25 to 60 percent slopes										
Miami loam, 25 to 60 percent slopes, moderately eroded										
Miami clay loam, 6 to 12 percent slopes, severely eroded	30	50	4	9	25	50	20	30	2. 0	3. 0
Miami clay loam, 12 to 18 percent slopes, severely eroded										
Miami clay loam, 18 to 25 percent slopes, severely eroded										
Miami clay loam, 25 to 60 percent slopes, severely eroded										
Montcalm loamy sand, 0 to 2 percent slopes	35	65	6	11	30	50	25	40	2. 0	3. 0
Montcalm loamy sand, 2 to 6 percent slopes	35	65	6	11	30	50	25	40	2. 0	3. 0
Montcalm loamy sand, 6 to 12 percent slopes	32	60	5	10	27	45	20	35	2. 0	3. 0
Montcalm loamy sand, 12 to 18 percent slopes	30	55	5	9	24	40	18	30	1. 8	2. 5
Montcalm loamy sand, 18 to 25 percent slopes										
Montcalm loamy sand, 25 to 50 percent slopes										
Montcalm sandy loam, 0 to 2 percent slopes	40	70	7	12	32	60	25	40	2. 0	3. 0
Montcalm sandy loam, 2 to 6 percent slopes	40	70	7	12	32	60	25	40	2. 0	3. 0
Morley loam, 2 to 6 percent slopes	50	75	9	12	50	70	30	45	2. 2	3. 5
Morley loam, 2 to 6 percent slopes, moderately eroded	45	70	8	11	45	68	28	42	2. 2	3. 5
Morley loam, 6 to 12 percent slopes	45	70	8	11	45	68	28	42	2. 0	3. 0
Morley loam, 6 to 12 percent slopes, moderately eroded	40	65	7	10	38	65	25	40	1. 8	2. 5
Morley loam, 12 to 18 percent slopes, moderately eroded					35	60	22	38	1. 5	2. 2
Morley clay loam, 6 to 12 percent slopes, severely eroded					25	40	15	25	1. 3	1. 8
Morley clay loam, 12 to 18 percent slopes, severely eroded									1. 3	1. 8
Morley clay loam, 18 to 25 percent slopes, severely eroded										
Munuscong sandy loam	30	70	5	12	35	50	25	35	1. 5	3. 0
Mussey-Gilford sandy loams	40	75	6	12	35	50	22	35	1. 8	3. 0
Nappanee loam, 0 to 2 percent slopes	35	80	7	13	40	55	25	35	1. 7	3. 5
Nappanee loam, 2 to 6 percent slopes	35	80	7	13	40	55	25	35	1. 7	3. 5
Nappanee silty clay loam, 0 to 2 percent slopes	35	80	7	13	40	55	25	35	1. 5	3. 0
Nappanee silty clay loam, 2 to 6 percent slopes, moderately eroded	28	60	5	9	30	50	28	30	1. 0	2. 5
Oshtemo sandy loam, 0 to 2 percent slopes	40	70	7	12	35	60	25	40	2. 0	3. 0
Oshtemo sandy loam, 2 to 6 percent slopes	40	70	7	12	35	60	25	40	2. 0	3. 0
Oshtemo sandy loam, 6 to 12 percent slopes	35	65	5	11	30	55	20	35	2. 0	3. 0
Owosso sandy loam, 0 to 2 percent slopes	45	85	8	14	45	65	30	40	2. 2	3. 5
Owosso sandy loam, 2 to 6 percent slopes	45	85	8	14	45	65	30	40	2. 2	3. 5
Owosso sandy loam, 6 to 12 percent slopes	40	75	7	12	40	60	27	35	2. 2	3. 5
Owosso sandy loam, 6 to 12 percent slopes, moderately eroded	40	75	7	12	40	60	27	35	2. 2	3. 5
Paulding clay	25	60	4	9	30	50	20	35	1. 2	2. 8
Pewamo loam	50	100	9	17	45	80	30	45	2. 0	3. 8
Pewamo clay loam	45	90	8	15	40	80	25	45	2. 0	3. 8
Pinconning loamy sand	25	65	4	10	25	45	15	30	1. 2	2. 2
Ritcher sandy loam, 0 to 2 percent slopes	55	85	9	13	45	65	30	45	2. 0	3. 5
Richter sandy loam, 2 to 6 percent slopes	55	85	9	13	45	65	30	45	2. 0	3. 5
Roselms clay loam, 0 to 2 percent slopes	27	50	5	8	32	50	22	35	1. 5	3. 0
Roselms clay loam, 2 to 6 percent slopes	27	50	5	8	32	50	22	35	1. 5	3. 0

TABLE 2.—*Predicted average yields under two levels of management*—Continued

Soil	Corn (grain)		Corn (silage)		Oats		Wheat		Alfalfa or alfalfa-brome hay	
	A	B	A	B	A	B	A	B	A	B
	Bu.	*Bu.*	*Tons*	*Tons*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*
Roselms clay loam, 2 to 6 percent slopes, moderately eroded	25	45	4	8	30	50	20	35	1. 2	2. 8
St. Clair silty clay loam, 2 to 6 percent slopes, moderately eroded	32	65	6	10	38	60	25	35	2. 0	3. 0
St. Clair silty clay loam, 6 to 12 percent slopes, moderately eroded	30	65	6	10	35	60	20	35	1. 8	2. 5
Sebewa loam	55	80	7	14	45	70	25	45	2. 0	3. 5
Sisson very fine sandy loam, 2 to 6 percent slopes	55	95	9	16	55	75	35	45	3. 0	4. 5
Sisson very fine sandy loam, 2 to 6 percent slopes, moderately eroded	50	90	8	15	50	70	32	40	3. 0	4. 5
Sisson very fine sandy loam, 6 to 12 percent slopes	45	85	7	14	45	70	30	40	3. 0	4. 0
Sisson very fine sandy loam, 6 to 12 percent slopes, moderately eroded	40	75	6	12	40	65	25	35	2. 3	3. 5
Sloan loam										
Spalding-Greenwood peats										
Spinks loamy sand, 0 to 2 percent slopes	30	55	5	8	30	50	20	30	1. 2	2. 3
Spinks loamy sand, 2 to 6 percent slopes	30	55	5	8	30	50	20	30	1. 2	2. 3
Spinks loamy sand, 6 to 12 percent slopes	27	50	4	7	25	45	18	25	1. 0	2. 0
Spinks loamy sand, 12 to 18 percent slopes	24	45	4	7	20	40	15	20	. 8	1. 8
Spinks loamy sand, 18 to 25 percent slopes										
Spinks loamy sand, 25 to 50 percent slopes										
Tawas muck	50	95	9	17						
Tedrow loamy sand, 0 to 2 percent	25	50	4	8	25	45	20	30	1. 2	2. 2
Tedrow loamy sand, 2 to 6 percent slopes	25	50	4	8	25	45	20	30	1. 2	2. 2
Tonkey fine sandy loam	55	95	7	16	45	70	25	45	1. 5	3. 5
Tuscola very fine sandy loam, 0 to 2 percent slopes	55	95	9	16	55	75	35	45	3. 0	4. 5
Tuscola very fine sandy loam, 2 to 6 percent slopes	55	95	9	16	55	75	35	45	3. 0	4. 5
Ubly sandy loam, 0 to 2 percent slopes	45	85	8	14	45	65	30	40	2. 2	3. 5
Ubly sandy loam, 2 to 6 percent slopes	45	85	8	14	45	65	30	40	2. 2	3. 5
Warners muck and marl										
Wasepi loamy sand, 0 to 2 percent slopes	50	80	8	12	45	60	25	40	2. 0	3. 0
Wasepi loamy sand, 2 to 6 percent slopes	50	80	8	12	45	60	25	40	2. 0	3. 0
Willette muck	50	95	9	17						

The figures in columns B represent yields obtained under improved management, which includes most of the following: suitable crop rotations, in which the proper proportion of row crops to legume-grass crops is maintained; such measures as are needed to control water erosion and soil blowing (contour tillage, stripcropping, minimum tillage, and return of crop residues, for example); applications of lime and fertilizer in accordance with the results of soil tests and the requirements of the crop; adequate artificial drainage, where needed; use of improved varieties of crops and of high-quality seed; control of weeds, diseases, and insects; suitable and well-timed tillage and harvesting; utilization of cover crops, crop residues, and manure to improve soil structure, supply organic matter, and help control erosion.

These yields are averages for a period of several years under the specified level of management. The predictions for improved management are not presumed to be the maximum obtainable; the potential yields under a favorable combination of conditions are somewhat higher. Irrigation is not considered a part of improved management, because it is little used except in the production of truck crops and fruit.

Woodland [1]

At one time, Lapeer County was almost entirely covered with forest. In the northern part of the county, northern hardwoods and pine grew on uplands and terraces and almost pure stands of hardwoods grew in the low, wet areas. In the southern part, central hardwoods predominated and scattered pine grew on uplands. White-cedar, balsam fir, and tamarack grew in wet bogs.

All of the woodland in the county has been cut over. Cutting began about 1865 and continued until about 1880. At first most of the cutting was for lumber, but later the remaining timber was cut and the stumps removed to make farmland.

At present, about 66,500 acres, nearly 16 percent of the county, is woodland. Part of the growing stock is sawtimber, and part is pole timber. Nearly 60 percent of the woodland consists of farm woodlots. The rest is State owned or is in residential holdings. The woodland acreage is expected to increase.

[1] RONALD WILSON, woodland conservationist, Soil Conservation Service, helped prepare this section.

Woodland is scattered throughout the county, but the largest areas are in soil associations 3, 11, and 12 (see the general soil map). Wood products are not a major source of income for farmers, but in recent years aspen has been harvested for pulp and about 525 acres has been planted to conifers, some for Christmas trees and some for future timber.

Of the farm woodland acreage, more than 60 percent is not used for pasture and is under some form of woodland management. The rest is used for pasture and shows the results of abuse and neglect. Heavy cutting, high grading, and continuous grazing have depleted the growing stock of the more valuable species and left only culls and low-value species on soils that could produce excellent timber. Woodland conservation practices can, in time, restore such woodlands to productivity. Protection from grazing, the killing of culls, and the removal and use of the low-value species are among the practices needed. Help in developing a woodland management program can be obtained from the district forester, Michigan Department of Conservation, or from a representative of the local Soil Conservation District.

Woodland suitability groups

To assist owners and managers in planning woodland management, the soils of Lapeer County are grouped into 14 woodland suitability groups. Each group consists of soils that are similar in potential productivity, in requirements for conservation practices, and in response to woodland management. Made land, Gravel pits, and Borrow pits are not placed in woodland suitability groups; woodland management of these small areas requires individual study.

Each woodland suitability group is identified by a letter of the alphabet. The grouping is on a statewide basis, and not all the groups in the system are represented in Lapeer County; consequently, the groups described here are not lettered consecutively.

The description of each group gives information about the pertinent properties of the soils, the major limitations, potential productivity for the major species, and selection of species for planting or for favored management. The major limitations, which are rated *slight*, *moderate*, or *severe* for each group, are seedling mortality, plant competition, equipment limitation, erosion hazard, and windthrow hazard.

Seedling mortality.—Unfavorable soil properties prevent the survival of some healthy natural or properly planted seedlings. A high water table, extreme acidity, droughtiness, and a high soil temperature are some of the properties that kill seedlings.

A seedling mortality rating of slight indicates that losses ordinarily do not exceed 25 percent of the planted stock. A rating of moderate indicates that losses are between 25 and 50 percent. A rating of severe indicates that more than 50 percent of the planted stock is likely to die.

Plant competition.—When a site has been disturbed by fire, logging, or other causes, undesirable kinds of brush, trees, grasses, or other plants may invade. This competing vegetation hinders or prevents the establishment of a stand of trees of the desired species.

A plant competition rating of slight indicates that competition does not prevent the reestablishment of a stand by natural means or interfere with the growth of planted seedlings. A rating of moderate indicates that competition delays the reestablishment of a stand of the desired species, by natural methods or by planting, but does not prevent the eventual development of a fully stocked stand. A rating of severe indicates that competition prevents the reestablishment of a woodland stand, by natural means or by planting, unless intensive site preparation measures and effective control practices are used.

Equipment limitation.—Poor drainage, unfavorable texture, strong slopes, and stoniness are among the soil characteristics that can restrict or prohibit the use of equipment commonly used in managing woodland and in harvesting trees. Different soils require different kinds of equipment, different methods of operation, or different seasons of use.

An equipment limitation rating of slight indicates that all equipment normally used can be operated without restrictions. A rating of moderate indicates that some restrictions exist for some types of equipment or that seasonal wetness limits the use of equipment for 1 to 3 months a year. A rating of severe indicates that special equipment is needed or that seasonal wetness limits the use of equipment for more than 3 months a year, and that the use of equipment damages the structure and stability of the soil and injures tree roots.

Erosion hazard.—Erosion can be controlled by using appropriate techniques in management and by using care in the construction and maintenance of roads, trails, and landings.

An erosion hazard rating of slight indicates that the soils are level or nearly so and that all operations can be carried out with minimum erosion control practices. A rating of moderate indicates that it is advisable to work on the contour and to limit the use of equipment in other ways. A rating of severe indicates that intensive measures are needed to control erosion.

Windthrow hazard.—Soil characteristics affect the development of tree roots, and root development determines the resistance of a tree to the force of the wind.

A windthrow hazard rating of slight indicates that trees are not likely to be blown down by commonly occurring winds. A rating of moderate indicates that some trees are likely to be blown down when the soil is unusually wet or the wind velocity is unusually high. A rating of severe indicates that adequate root development is prevented by a high water table, a pan, or some other unfavorable characteristic, and that many trees probably will be blown down.

Potential productivity.—The ratings of potential productivity used in the descriptions of the woodland suitability groups indicate average annual growth. They can be translated into terms of board feet per acre or cords per acre, as follows: *Very high*, more than 325 board feet or more than 1.5 cords; *high*, 300 board feet or 1 cord; *medium*, 240 board feet or 0.8 cord; *low*, 160 board feet or 0.3 cord; and *very low*, less than 125 board board feet or less than 0.1 cord.

Species priority.—The suggestions for species to be preferred for planting and species to be favored in managing the natural stands are based on the suitability of the soils for the different species and the relative commercial value of the suitable species. Disease and

insect hazards are not taken into account. The species are named in the order of preference.

WOODLAND SUITABILITY GROUP A

This group consists of moderately well drained to well drained, level to steep soils of the Alcona and McBride series. The McBride soils have a fragipan that can inhibit the growth of roots.

Permeability of these soils is moderate. The available water capacity is moderate. Aeration is generally good but is restricted within the fragipan and during the wet months in spring and fall. Fertility is medium.

The limitations of these soils for the production of trees are rated as follows: Seedling mortality, slight; plant competition, moderate; equipment limitation, slight; erosion hazard, slight to moderate; windthrow hazard, slight.

These limitations do not prevent or significantly delay the reestablishment of well-stocked stands of desirable species. Stands can be established either by planting or by natural regeneration. Where the slope is more than 6 percent, it is advisable to run roads and trails on the contour, to plant on the contour, and to operate logging equipment on the contour. Where the slope exceeds 18 percent, the use of equipment is limited to some extent, and planting must be done by hand.

Potential productivity is high for pine and also for aspen, oak, and other hardwoods. White pine, red pine, and white spruce are the species to be preferred for planting. Sugar maple, white pine, red pine, and basswood are the species to be favored in the natural stands.

WOODLAND SUITABILITY GROUP B

This group consists of moderately well drained to well drained, gently sloping to moderately steep soils of the Morley and St. Clair series.

Permeability of these soils is moderately slow to very slow. Except for the soils that are severely eroded, aeration is fair, the available water capacity is high, and fertility is moderately high. The severely eroded soils have impaired aeration and reduced available water capacity.

The limitations of these soils for the production of trees are rated as follows: Seedling mortality, moderate to severe; plant competition, moderate to severe; equipment limitation, moderate; erosion hazard, moderate; windthrow hazard, slight.

The effects of these limitations are moderately serious. So many natural seedlings may be lost that planting will be necessary to restock the stands. Plant competition delays and can possibly prevent the establishment of adequate stands of desirable species. Chemical or mechanical treatment or special site preparation may be needed to control the competing vegetation so that seedlings can get established. The use of equipment is limited where the slope exceeds 18 percent. On the lesser slopes, wetness restricts the use of equipment for as much as 3 months out of the year. Careless use of equipment can damage tree roots. For control of erosion, it is advisable to run roads and trails on the contour, to plant on the contour, and to operate logging equipment on the contour. Windthrow is a significant hazard only in open stands.

Potential productivity is low for pine but medium for aspen, oak, and other hardwoods. Norway spruce and white spruce, neither of which occurs in the natural stands, are the species to be preferred for planting. White pine can be planted where the soils are not severely eroded. Both red pine and white pine are subject to insect infestation. Red oak, white oak, sugar maple, and basswood are the species to be favored in the natural stands.

WOODLAND SUITABILITY GROUP C

This group consists of moderately well drained to well drained, level to moderately steep soils of the Mancelona and Menominee series.

Permeability is rapid in the upper part of these soils and moderately slow in the lower part. The available water capacity is moderate. Aeration is good. Fertility is moderately low.

The limitations of these soils for the production of trees are rated as follows: Seedling mortality, slight; plant competition, slight; equipment limitation, slight; erosion hazard, slight to moderate; windthrow hazard, slight.

These limitations do not prevent or significantly delay the establishment of well-stocked stands of desirable species, either by planting or by natural seeding. Droughtiness is a hazard in some areas in dry years. Insects and diseases, although not serious hazards, present some management problems. Because of the slight to moderate risk of erosion, roads and trails should be run on the contour and equipment should be operated on the contour.

Potential productivity is high for pine, medium for aspen, low to medium for oak, and medium for other hardwoods. White pine, red pine, and white spruce are the species to be preferred for planting. Red pine, sugar maple, and white pine are the species to be favored in the natural stands.

WOODLAND SUITABILITY GROUP D

This group consists of moderately well drained to well drained, level to very steep, uneroded to severely eroded soils of the Celina, Marlette, and Miami series and one land type, Gullied land, loamy.

Permeability of these soils is moderately slow. Fertility is high. The uneroded soils have a high available water capacity and fair aeration. The moderately and severely eroded soils have a lower available water capacity than the uneroded ones and also are less well aerated, have poorer tilth and less favorable texture, and are subject to heavier runoff.

The limitations of these soils for the production of trees are rated as follows: Seedling mortality, slight; plant competition, moderate; equipment limitation, slight to severe; erosion hazard, moderate; windthrow hazard, slight.

These limitations do not prevent the establishment of adequate stands of desirable species, but the moderate degree of plant competition delays it somewhat. Some seedlings may have to be replaced unless competing vegetation is controlled either by chemical or mechanical methods or by special site preparation practices. Where the slope is more than 6 percent, it is advisable to run roads and trails on the contour and to operate logging equipment on the contour. The equipment limitation is significant only where the slope is more than 18 percent.

Potential productivity is low for pine, high for spruce, very high for aspen, and very high for oak and other hardwoods. White spruce and Norway spruce, neither of which occurs in the natural stands, are the species to be preferred for planting. White pine can be planted where the soils are not severely eroded, but the economic feasibility of growing pine on these soils is questionable. Red oak, white oak, and white ash are the species to be favored in the natural stands.

WOODLAND SUITABILITY GROUP E

This group consists of well-drained, level to very steep soils of the Chelsea and Spinks series and one land type, Gullied land, sandy.

Permeability of these soils is moderately rapid to rapid, aeration is good, the available water capacity is low to moderately low, and fertility is very low to low.

The limitations of these soils for the production of trees are rated as follows: Seedling mortality, slight; plant competition, slight; equipment limitation, slight to severe; erosion hazard, slight to moderate; windthrow hazard, slight.

These limitations do not prevent or significantly delay the establishment of adequate stands of desirable species, either by planting or by natural seeding. The limitation on the use of equipment results from steep slopes and sandy texture. Building roads and trails on the contour makes it possible to use equipment without causing excessive erosion. The erosion hazard, though generally no more than moderate, is severe where the slope is more than 18 percent.

Potential productivity is medium to high for pine, very low to low for spruce, medium for aspen, and low to medium for oak and other hardwoods. Red pine and white pine are the species to be preferred for planting. White pine, red pine, and sugar maple are the species to be preferred in the natural stands.

WOODLAND SUITABILITY GROUP F

This group consists of somewhat poorly drained, level to gently sloping soils of the Au Gres and Tedrow series. One of the Au Gres soils has a substratum of loamy to clayey material at a depth of 42 to 66 inches.

Permeability of these soils is moderately rapid to rapid, the available water capacity is low to moderately low, and fertility is low. Aeration is variable because of a fluctuating high water table.

The limitations of these soils for the production of trees are rated as follows: Seedling mortality, moderate; plant competition, moderate; equipment limitation, moderate; erosion hazard, slight; windthrow hazard, moderate.

These limitations are serious enough to delay the reestablishment of adequate stands of desirable species. Special site preparation or other measures are needed for control of competing vegetation. Wetness during spring and after rain in other seasons restricts the use of equipment, but generally for no more than 3 months in a year. Windthrow is a hazard, especially if openings are left when trees are removed, because root development is restricted and trees are not stable when the soils are excessively wet or when the wind velocity is high. Soil blowing is a hazard in dry weather.

Potential productivity is low for pine, low to medium for spruce, medium for aspen, and low for other hardwoods. Tree planting is not normally undertaken. Aspen and spruce are to be favored in managing the natural stands. Aspen rates highest in potential productivity, but it is of low value and in addition is subject to Hypoxylon canker. Oak is scarce and of poor quality. Economic returns from wood crops are likely to be low.

WOODLAND SUITABILITY GROUP G

This group consists of somewhat poorly drained, level to gently sloping soils of the Allendale, Belding, Brady, Fabius, Iosco, Kibbie, Locke, Macomb, Matherton, Metamora, Richter, and Wasepi series.

All these soils have a fluctuating high water table and consequently are saturated in spring and during wet weather in other seasons. Permeability and aeration are variable because of the fluctuations in the water table. Both fertility and the available water capacity are mainly moderate but range from low to moderately high.

The limitations of these soils for the production of trees are rated as follows: Seedling mortality, severe; plant competition, severe; equipment limitation, moderate; erosion hazard, slight; windthrow hazard, moderate.

These limitations interfere seriously with the establishment of adequate stands of desirable species. The use of equipment is restricted or prevented by wetness for about 3 months out of the year. Because of the high water table, the development of tree roots is restricted and trees are not stable enough to resist windthrow if released on all sides. The natural stands include many elms, and Dutch elm disease is common.

Potential productivity is low for pine, medium for spruce, medium for aspen, and low for other hardwoods. Planting is practical only if drainage is improved artificially. Norway spruce, white spruce, white-cedar, and white pine are the species to be preferred for planting where drainage has been provided. White ash, red maple, and silver maple are the species to be favored in managing the natural stands.

WOODLAND SUITABILITY GROUP J

This group consists of very poorly drained, level or depressional, organic soils of the Adrian, Carlisle, Edwards, Greenwood, Houghton, Linwood, Lupton, Spalding, Tawas, Warners, and Willette series.

These soils have a high water table and are saturated most of the year. Permeability is rapid in the organic layers and variable in the mineral layers. Aeration is poor. The available water capacity is high, and fertility is low.

The limitations of these soils for the production of trees are rated as follows: Seedling mortality, severe; plant competition, severe; equipment limitation, severe; erosion hazard, slight; windthrow hazard, severe.

These limitations, in addition to the excessive wetness of the soils, make the establishment of trees very difficult. The severe limitation on the use of equipment is a result of the high water table and poor bearing capacity. Harvesting is possible only when the soils are frozen. The shallow root zone and the instability of the soil material account for the severe hazard of windthrow.

Little information is available on potential productivity. Growth of trees is extremely variable; it is governed mainly by the depth to the water table. The natural stands consist of lowland hardwoods and swamp conifers. Very few areas of Spalding and Greenwood peats support trees.

WOODLAND SUITABILITY GROUP M

This group consists of moderately well drained to well drained, level to very steep soils of the Boyer, Montcalm, and Oshtemo series.

Permeability of these soils is moderately rapid, aeration is good, the available water capacity is moderately low, and fertility is low to moderately low.

The limitations of these soils for the production of trees are rated as follows: Seedling mortality, slight to moderate; plant competition, slight to moderate; equipment limitation, slight to moderate; erosion hazard, slight to moderate; windthrow hazard, slight.

These limitations do not prevent the establishment of adequate stands of desirable species, though plant competition may delay it somewhat. Planting may be needed to fill in spots where seedlings have failed, unless competing vegetation is controlled by chemical or mechanical means or by special site preparation. Where the slope is more than 6 percent, it is advisable to run roads and trails on the contour, to plant on the contour, and to operate logging equipment on the contour. Where the slope exceeds 18 percent, the use of equipment is limited significantly.

Potential productivity is medium to high for pine, low to medium for spruce, and low to medium for hardwoods. White pine, red pine, and white spruce are the species to be preferred for planting. Oak, sugar maple, and basswood are the species to be favored in the natural stands.

WOODLAND SUITABILITY GROUP O

This group consists of poorly drained to well-drained, level or depressional soils of the Abscota, Algansee, Ceresco, Cohoctah, Glendora, and Sloan series. These soils are on bottom lands and are subject to flooding.

Permeability of these soils ranges from moderate to rapid. Fertility and the available water capacity range from low to high. The somewhat poorly drained and poorly drained soils of the group are saturated because of a high water table and are poorly aerated.

The limitations of these soils for the production of trees are rated as follows: Seedling mortality, moderate; plant competition, moderate to severe; equipment limitation, moderate to severe; erosion hazard, slight; windthrow hazard, moderate to severe.

The effects of these limitations vary in severity, depending on the frequency of flooding. Plant competition delays or prevents the reestablishment of adequate stands through natural regeneration. Special site preparation and other measures are needed for control of competing vegetation. Flooding also interferes with the germination of seed and the growth of seedlings. Excessive wetness restricts or prohibits the use of equipment for as much as 3 months out of the year. Windthrow is most likely during periods of flooding and high winds. Although the erosion hazard is slight, some gullying and streambank cutting take place. Dutch elm disease is prevalent.

Potential productivity varies, depending on drainage and on the frequency of overflow. Only cottonwood is suitable for planting.

WOODLAND SUITABILITY GROUP P

This group consists of very poorly drained to poorly drained, level or depressional soils of the Berville, Brookston, Hoytville, Lenawee, Paulding, and Pewamo series.

All the soils of this group have a high water table and are saturated unless artificially drained. Permeability is very slow to moderately slow, aeration is poor, the available water capacity is moderately high to high, and fertility is moderately high to high.

The limitations of these soils for the production of trees are rated as follows: Seedling mortality, severe; plant competition, severe; equipment limitation, severe; erosion hazard, slight; windthrow hazard, severe.

These limitations and the excessive wetness of the soils seriously impede the reestablishment of stands through natural regeneration, and planting is not likely to be successful unless the soils are drained artificially and the planting sites receive special preparation. For more than 3 months out of the year, the use of equipment is difficult or impossible because of the high water table. Because of the severe hazard of windthrow, it is advisable to harvest by clear cutting in strips or patches, so as not to leave individual trees exposed to the wind. Dutch elm disease is a serious hazard, and other fungus diseases are likely to occur.

Potential productivity is low to medium for most species. Red maple, white ash, and basswood are the species to be favored in managing the natural stands. Natural stands of spruce, aspen, and lowland hardwoods are poor. Upland oak and pine do not grow on these soils. Planting generally is not practical unless artificial drainage is provided.

WOODLAND SUITABILITY GROUP U

This group consists of moderately well drained and well drained, level to very steep, uneroded to severely eroded soils of the Dryden, Fox, Lapeer, Owosso, Sisson, Tuscola, and Ubly series.

Permeability of these soils is generally moderate, and fertility is medium to high. The uneroded and moderately eroded soils have good aeration and a moderate to high available water capacity. The severely eroded soils have a lower available water capacity and are less well aerated.

The limitations of these soils for the production of trees are rated as follows: Seedling mortality, slight; plant competition, moderate; equipment limitation, slight to moderate; erosion hazard, slight to moderate; windthrow hazard, slight.

These limitations do not prevent the establishment of adequate stands of desirable species, but competition from brush and weed trees causes some delay. Special site preparation or chemical or mechanical control of the competing vegetation is needed. Where the slope is more than 18 percent, the use of equipment is limited and planting must be done by hand. The use of logging equipment when the soil is wet is likely to cause some damage to tree roots. Where the slope is more than 6 percent, it is advisable to run roads and trails on the contour, and

to operate logging equipment on the contour. Plantations of conifers are subject to infestation with several kinds of insects.

Potential productivity is high for pine and spruce and for oak and other hardwoods. White pine, red pine, Norway spruce, and white spruce are the species to be preferred for planting. Spruce does not occur naturally, but can be established by planting. Red oak, white ash, white oak, and sugar maple are the species to be favored in the natural stands.

WOODLAND SUITABILITY GROUP W

This group consists of poorly drained, level or depressional soils of the Barry, Breckenridge, Brevort, Colwood, Gilford, Granby, Munuscong, Mussey, Pinconning, Sebewa, and Tonkey series.

These soils have a high water table and are saturated unless drained artificially. They differ widely in permeability. Aeration is poor. Fertility ranges from low to moderately high, and the available water capacity ranges from low to high.

The limitations of these soils for the production of trees are rated as follows: Seedling mortality, severe; plant competition, severe; equipment limitation, severe; erosion hazard, slight; windthrow hazard, severe.

These limitations make it almost impossible for trees to become reestablished through natural regeneration. Planting is not successful unless the soils are drained artificially and the sites receive special preparation. The high water table restricts the use of equipment and also limits the development of roots and thereby makes the trees susceptible to windthrow. Dutch elm disease is a serious hazard, and other fungus diseases are likely to occur.

Potential productivity is low to very low for aspen and other hardwoods and low for spruce, white-cedar, and swamp conifers. Pine and oak are not suited to these soils. Spruce and white-cedar should be favored in managing the existing stands. Because of the generally low productivity, no priority for planting is suggested.

WOODLAND SUITABILITY GROUP Z

This group consists of somewhat poorly drained, level to gently sloping soils of the Blount, Capac, Conover, Del Rey, Nappanee, and Roselms series.

These soils have a fluctuating high water table. Permeability is very slow to moderately slow, aeration is generally poor, the available water capacity is moderately high to high, and fertility is moderately high to high.

The limitations of these soils for the production of trees are rated as follows: Seedling mortality, moderate; plant competition, severe; equipment limitation, moderate; erosion hazard, slight; windthrow hazard, moderate.

These limitations and the poor drainage delay and may prevent the establishment of adequate stands of desirable species. Special site preparation and control of competing vegetation by either chemical or mechanical means are necessary. Many areas need to be drained artificially. Because of the windthrow hazard, cutting practices that leave individual trees released on all sides should be avoided. Excessive wetness limits the use of equipment for as much as 3 months out of the year. Dutch elm disease and other fungus diseases are prevalent.

Potential productivity is low for pine, medium for aspen, and medium for oak and other hardwoods. White spruce, white pine, and Norway spruce are the species to be preferred for planting. Red oak, white ash, and basswood are the species to be favored in the natural stands.

Wildlife [2]

Table 3 shows the relative suitability of the soils of Lapeer County for eight elements of wildlife habitat and for three kinds of wildlife. The ratings given in this table are based on soil properties only. Present land use, existing vegetation, and artificial drainage were disregarded, because they are subject to change. Also disregarded were the size and shape of the soil areas and relations to adjoining soils. The ratings make it possible to judge what degree of success can be expected if a given area is managed as wildlife habitat, and what intensity of management is necessary.

Each soil is rated as *not suited*, *poorly suited*, *suited*, or *well suited* for each of the following:

Grain and seed crops.—In this category are corn, wheat, oats, barley, rye, buckwheat, millet, sorghum, soybeans, and sunflowers.

Grasses and legumes.—In this category are some of the common planted forage plants. Examples are brome, fescue, timothy, redtop, trefoil, orchardgrass, reed canarygrass, clover, alfalfa, and sudangrass.

Wild herbaceous upland plants.—In this category are native annuals and perennials. Examples are strawberries, dandelions, goldenrod, wild oats, nightshade, ragweed, lambsquarters, and native grasses.

Hardwood woody plants.—In this category are trees and shrubs, both native and planted, that grow vigorously and produce heavy crops of fruit or seed. Examples are maple, beech, oak, poplar, birch, dogwood, raspberry, blackberry, cherry, hawthorn, viburnum, grape, blueberry, willow, and wintergreen.

Coniferous woody plants.—In this category are native and planted trees and shrubs. Examples are pine, spruce, white-cedar, hemlock, balsam fir, yew, larch, and juniper.

Wetland food and cover plants.—In this category are plants that provide food and cover for waterfowl and for furbearing animals. Examples are cattail, sedge, bulrush, smartweed, wild millet, waterplantain, wildrice, arrowhead, pondweed, pickerelweed, wildcelery, duckweed, and burreed.

Shallow water developments.—These are impoundments in which shallow water can be maintained at a desired level. Examples of the structures that may be used are low dikes, level ditches, shallow dugouts, and devices for controlling the water level in marshy streams and channels.

Excavated ponds.—Ponds of this kind should not depend on runoff for a continuing supply of water, but runoff may be beneficial if it is not excessive and does

[2] BRUCE G. WATSON, soil scientist, and CHARLES M. SMITH, biologist, Soil Conservation Service, prepared this section.

not cause harmful silting. Such ponds attract migrating waterfowl.

On the basis of suitability for these eight elements of wildlife habitat, each soil is rated *not suited*, *poorly suited*, *suited*, or *well suited* as a habitat for the following:

Openland wildlife.—In this class are birds and mammals that normally frequent cropland, pastures, meadows, and areas overgrown with grasses, herbs, and shrubs. Examples are quail, pheasant, meadowlarks, prairie chickens, field sparrows, red foxes, cottontail rabbits, woodchucks, and hawks.

Woodland wildlife.—In this class are birds and mammals that normally frequent areas that have a cover of hardwood trees, coniferous trees, shrubs, or mixtures of these. Examples are squirrels, raccoons, ruffed grouse, woodcock, turkeys, woodpeckers, warblers, nuthatches, deer, snowshoe rabbits, bear, bobcats, gray foxes, and owls.

Wetland wildlife.—In this class are birds and mammals that frequent ponds, marshes, and swamps. Examples are muskrats, beavers, otter, ducks, geese, herons, rails, kingfishers, mink, cranes, and bitterns.

Engineering Uses of the Soils

This section will be of special interest to engineers, contractors, farmers, and others who use soils as structural or foundation material. Tables 4, 5, 6, and 7 describe and interpret soil properties that affect the construction and maintenance of roads and airports, pipelines, building foundations, water storage facilities, erosion control structures, drainage systems, and sewage disposal systems. Among the soil properties most significant in engineering are permeability, shear strength, density, shrink-swell potential, available water capacity, grain-size distribution, plasticity, and reaction.

The information given in this section can be used in—

1. Planning and designing agricultural drainage systems, farm ponds, irrigation systems, diversion terraces, and other structures for controlling water and conserving soil.
2. Selecting potential locations for highways, airports, pipelines, and underground cables.
3. Locating probable sources of sand or gravel suitable for use as construction material.
4. Selecting potential industrial, commercial, residential, and recreational areas.

The data and interpretations reported here do not eliminate the need for sampling and testing at the site of specific engineering works involving heavy loads or excavations deeper than the depths of the layers here described. Even in these situations, however, this section and the soil map are useful in that they indicate the kinds of problems that may be expected and provide a basis for planning detailed field investigations.

Some terminology used by soil scientists may be unfamiliar to engineers, and some words have different meanings in soil science than they have in engineering. Among the words that have special meanings in soil science are the following: gravel, sand, silt, clay, loam, surface soil, subsoil, and horizon. These and other special terms are defined in the Glossary at the back of this publication.

Engineering classification systems

Two systems of classifying soils for engineering are in general use. One was developed by the American Association of State Highway Officials (AASHO) (*1*) [3] and is commonly used by highway engineers. The other, known as the Unified system, was developed by the U.S. Army Corps of Engineers (*8*). It is the one generally used by Soil Conservation Service engineers.

In the AASHO system, each soil is placed in one of seven basic groups, ranging from A–1 through A–7, on the basis of grain-size distribution, liquid limit, and plasticity index. In group A–1 are gravelly soils of high bearing strength, the best soils for subgrade (foundation). At the other extreme, in group A–7, are clay soils that have low strength when wet and are the poorest soils for subgrade. If laboratory data are available to justify a further breakdown, the A–1 group is subdivided into A–1–a and A–1–b; the A–2 group into A–2–4, A–2–5, A–2–6, and A–2–7; and the A–7 group into A–7–5 and A–7–6. Also, provided that laboratory data are available, the relative engineering values of the soils within any group can be indicated by group index numbers, which range from 0 for the best soils in the group to 20 for the poorest. The group index number, if one has been determined, is added in parentheses to the group symbol, in this manner: A–1–a(0).

In the Unified system, soils are classified into 15 groups, according to particle-size distribution, plasticity, liquid limit, and organic-matter content. There are eight classes of coarse-grained soils, identified by the symbols GW, GP, GM, GC, SW, SP, SM, and SC: six classes of fine-grained soils, identified by the symbols ML, CL, OL, MH, CH, and OH; and one class of highly organic soils, identified by the symbol Pt.

Table 4 gives both the AASHO and the Unified classifications for tested soils of Lapeer County; table 5 gives estimated classifications, according to both systems, for all the soils mapped in the county. Table 5 also gives the USDA textural classification for each soil. In this system, used by the agricultural scientists, the classification is based on the proportions of sand, silt, and clay particles.

Engineering test data

Table 4 gives data obtained by laboratory analysis of three soils representing three different series. Each soil was sampled at three different locations. Not all layers of all soils are represented. The samples were analyzed according to standard procedures in the laboratories of the Bureau of Public Roads. The data obtained do not represent the entire range of soil properties in the county, or even the entire range for the three series sampled.

The mechanical analysis data were obtained by a combination of the sieve and hydrometer methods. The particle-size classes do not coincide with those used in the system by which the USDA textural classes are determined (*6*).

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[3] Italic numbers in parentheses refer to Literature Cited, p. 148.

TABLE 3.—*Suitability of soils for elements of*

["Well suited" means the soils have no limitations that cannot easily be overcome; "suited" means limitations need to be recognized but wildlife habitat is questionable; "not suited" means extreme measures would be needed to

Soil series and map symbols	Elements of wildlife habitat			
	Grain and seed crops	Grasses and legumes	Wild herbaceous upland plants	Hardwood woody plants
Abscota: Ab	Suited	Suited	Well suited	Suited
Adrian: Ad	Not suited	Not suited	Poorly suited	Not suited
Alcona: AlA, AlB, AlC	Well suited	Well suited	Well suited	Well suited
Algansee: An	Suited	Suited	Well suited	Suited
Allendale: AoA, AoB	Suited	Suited	Well suited	Suited
Au Gres: AsB, AuA	Suited	Suited	Well suited	Suited
Barry: Ba	Well suited [1]	Well suited [1]	Well suited [1]	Well suited [1]
Belding: BeA, BeB	Suited	Suited	Well suited	Suited
Belding, clay subsoil variant: BfA, BfB	Suited	Suited	Well suited	Suited
Berville: Bh	Well suited [1]	Well suited [1]	Well suited [1]	Well suited [1]
Blount: BlA, BlB, BlB2	Suited	Suited	Well suited	Well suited
Borrow pits: Bp	[2]	[2]	[2]	[2]
Boyer:				
BrA, BrB, BrC, BsA, BsB, BsC	Suited	Suited	Well suited	Suited
BrD, BsD	Poorly suited	Poorly suited	Well suited	Suited
BrE, BrF	Not suited	Poorly suited	Well suited	Suited
Brady: BtA, BtB	Suited [1]	Suited [1]	Well suited	Well suited
Breckenridge: Bu	Well suited [1]	Well suited [1]	Well suited [1]	Well suited [1]
Brevort: Bv	Suited [1]	Suited [1]	Well suited [1]	Well suited [1]
Brookston: Bw	Well suited [1]	Well suited [1]	Well suited [1]	Well suited [1]
Capac: CaA, CaB	Suited	Suited	Well suited	Well suited
Carlisle: Cc	Not suited	Not suited	Poorly suited	Not suited
Celina: CeA, CeB, CeB2	Well suited	Well suited	Well suited	Well suited
Ceresco: Cf	Suited	Suited	Well suited	Well suited
Chelsea: ChB, ChC, ChD	Not suited	Not suited	Poorly suited	Poorly suited
Cohoctah: Cm	Not suited [3]	Poorly suited [3]	Poorly suited [3]	Suited
Colwood: Co	Well suited [1]	Well suited [1]	Well suited [1]	Well suited [1]
Conover: CvA, CvB	Suited	Suited	Well suited	Well suited
Del Rey: DrA, DrB	Suited	Suited	Well suited	Well suited
Dryden: DyA, DyB	Well suited	Well suited	Well suited	Well suited
Edwards: Ed	Not suited	Not suited	Poorly suited	Not suited
Fabius: FaA, FaB	Suited	Suited	Well suited	Well suited
For Wasepi part of these mapping units, see Wasepi series.				
Fox: FoA, FoB, FoC2	Well suited	Well suited	Well suited	Well suited
Gilford: Gd	Suited [1]	Suited [1]	Well suited [1]	Well suited [1]
Glendora: Ge	Not suited [3]	Not suited [3]	Poorly suited [3]	Suited [3]
Granby: Gm, Gn	Suited [1]	Suited [1]	Well suited [1]	Well suited [1]
Gravel pits: Gr	[2]	[2]	[2]	[2]
Greenwood	Not suited	Not suited	Not suited	Not suited
Mapped only with Spalding soils.				
Gullied land: Gs, Gu	Poorly suited	Poorly suited	Poorly suited	Poorly suited
Houghton: Ho	Not suited	Not suited	Poorly suited	Not suited
Hoytville: Ht, Hy	Poorly suited [1]	Well suited [1]	Suited [1]	Well suited [1]
Iosco: IoA	Suited	Suited	Well suited	Suited
Kibbie: KbA, KbB	Suited	Suited	Well suited	Well suited
Lapeer:				
LaA, LaB, LaB2, LaC, LaC2, LaC3	Well suited	Well suited	Well suited	Well suited
LaD2, LaD3	Poorly suited	Suited	Well suited	Well suited
LaE2, LaE3, LaF	Not suited	Poorly suited	Well suited	Well suited
Lenawee: Le	Well suited [1]	Well suited [1]	Well suited [1]	Well suited [1]
Linwood: Lm	Not suited	Not suited	Poorly suited	Not suited
Locke: LoA, LoB	Suited	Suited	Well suited	Well suited
Lupton: Lu	Not suited	Not suited	Poorly suited	Not suited
Macomb: MaA, MaB	Suited	Suited	Well suited	Well suited
Made land: Md	[2]	[2]	[2]	[2]
Mancelona, moderately fine substratum: MeB, MeC2.	Suited	Suited	Well suited	Suited

See footnotes at end of table.

wildlife habitat and for kinds of wildlife

can be overcome through good management and careful design; "poorly suited" means limitations are severe, and the use of the soils for overcome limitations, and use of the soils for wildlife habitat is generally unsound or impractical]

Elements of wildlife habitat—Continued				Kinds of wildlife		
Coniferous woody plants	Wetland food and cover plants	Shallow water developments	Excavated ponds	Openland wildlife	Woodland wildlife	Wetland wildlife
Poorly suited	Not suited	Not suited	Not suited	Well suited	Suited	Not suited.
Not suited	Well suited	Well suited	Well suited	Not suited	Not suited	Suited.
Poorly suited	Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Poorly suited	Suited	Suited	Suited	Well suited	Suited	Suited.
Poorly suited	Suited	Suited	Suited	Well suited	Suited	Suited.
Poorly suited	Suited	Suited	Suited	Well suited	Suited	Suited.
Suited	Well suited	Well suited	Well suited	Well suited [1]	Well suited	Well suited.
Poorly suited	Suited	Suited	Suited	Well suited	Suited	Suited.
Poorly suited	Suited	Suited	Suited	Well suited	Suited	Suited.
Suited	Well suited	Well suited	Well suited	Well suited [1]	Well suited	Well suited.
Poorly suited	Suited	Suited	Suited	Well suited	Poorly suited	Suited.
(2)	(2)	(2)	(2)	(2)	(2)	(2).
Poorly suited	Not suited	Not suited	Not suited	Well suited	Suited	Not suited.
Poorly suited	Not suited	Not suited	Not suited	Suited	Suited	Not suited.
Poorly suited	Not suited	Not suited	Not suited	Poorly suited	Poorly suited	Not suited.
Poorly suited	Suited	Suited	Suited	Well suited [2]	Suited	Suited.
Suited	Well suited	Well suited	Well suited	Well suited [1]	Well suited [1]	Well suited.
Suited	Well suited	Well suited	Well suited	Well suited [1]	Suited	Well suited.
Suited	Well suited	Well suited	Well suited	Well suited [1]	Well suited [1]	Well suited.
Poorly suited	Suited	Suited	Suited	Well suited	Well suited	Suited.
Not suited	Well suited	Well suited	Well suited	Not suited	Not suited	Well suited.
Poorly suited	Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Poorly suited	Suited	Suited	Suited	Well suited	Suited	Suited.
Well suited	Not suited	Not suited	Not suited	Not suited	Poorly suited	Not suited.
Well suited	Well suited	Well suited	Well suited	Not suited [3]	Suited	Well suited.
Suited	Well suited	Well suited	Well suited	Well suited [1]	Well suited [2]	Well suited.
Poorly suited	Suited	Suited	Suited	Well suited	Well suited	Suited.
Poorly suited	Suited	Suited	Suited	Well suited	Well suited	Suited.
Poorly suited	Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Not suited	Well suited	Well suited	Well suited	Not suited	Not suited	Suited.
Poorly suited	Suited	Suited	Suited	Well suited	Suited	Suited.
Poorly suited	Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Suited	Well suited	Well suited	Well suited	Not suited [3]	Suited [3]	Well suited.
Suited	Well suited	Well suited	Well suited	Well suited [1]	Well suited [1]	Well suited.
(2)	(2)	(2)	(2)	(2)	(2)	(2).
Not suited	Well suited	Well suited	Well suited	Not suited	Not suited	Suited.
Well suited	Not suited	Not suited	Not suited	Not suited	Not suited	Not suited.
Not suited	Well suited	Well suited	Well suited	Not suited	Not suited	Suited.
Suited	Well suited	Well suited	Well suited	Suited [1]	Well suited	Well suited.
Poorly suited	Suited	Suited	Suited	Well suited	Suited	Suited.
Poorly suited	Suited	Suited	Suited	Well suited	Well suited	Suited.
Poorly suited	Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Poorly suited	Not suited	Not suited	Not suited	Suited	Well suited	Not suited.
Poorly suited	Not suited	Not suited	Not suited	Poorly suited	Suited	Not suited.
Suited	Well suited	Well suited	Well suited	Well suited [1]	Well suited [1]	Well suited.
Not suited	Well suited	Well suited	Well suited	Not suited	Not suited	Suited.
Poorly suited	Suited	Suited	Suited	Well suited	Well suited	Suited.
Not suited	Well suited	Suited	Well suited	Not suited	Not suited	Suited.
Poorly suited	Suited	Suited	Suited	Well suited	Well suited	Suited.
(2)	(2)	(2)	(2)	(2)	(2)	(2).
Poorly suited	Not suited	Not suited	Not suited	Well suited	Suited	Not suited.

TABLE 3.—*Suitability of soils for elements of*

Soil series and map symbols	Elements of wildlife habitat			
	Grain and seed crops	Grasses and legumes	Wild herbaceous upland plants	Hardwood woody plants
Marlette:				
MfA, MfB, MfB2, MfC, MfC2, MfC3	Well suited	Well suited	Well suited	Well suited
MfD2, MfD3	Poorly suited	Suited	Well suited	Well suited
MfE2, MfF2	Not suited	Poorly suited	Well suited	Well suited
Matherton: MhA, MhB	Suited	Suited	Well suited	Well suited
McBride:				
MkB, MkB2, MkC2, MlA, MlB, MlB2, MlC, MlC2, MlC3.	Well suited	Well suited	Well suited	Well suited
MlD, MlD2, MlD3	Poorly suited	Suited	Well suited	Well suited
MlE2, MlF	Not suited	Poorly suited	Well suited	Well suited
Menominee:				
MmA, MmB, MmC	Suited	Suited	Well suited	Suited
MmD	Poorly suited	Poorly suited	Well suited	Suited
Metamora: MnA, MnB	Suited	Suited	Well suited	Well suited
Miami:				
MoB, MoB2, MoC, MoC2, MpC3	Well suited	Well suited	Well suited	Well suited
MoD, MoD2, MpD3	Poorly suited	Suited	Well suited	Well suited
MoE, MoE2, MoF, MoF2, MpE3, MpF3	Not suited	Poorly suited	Well suited	Well suited
Montcalm:				
MrA, MrB, MrC, MsA, MsB	Suited	Suited	Well suited	Suited
MrD	Poorly suited	Poorly suited	Well suited	Suited
MrE, MrF	Not suited	Not suited	Well suited	Suited
Morley:				
MtB, MtB2, MtC, MtC2, MuC3	Well suited	Well suited	Well suited	Well suited
MtD2, MuD3	Poorly suited	Suited	Well suited	Well suited
MuE3	Not suited	Poorly suited	Well suited	Well suited
Munuscong: Mv	Well suited [1]	Well suited [1]	Well suited [1]	Well suited [1]
Mussey: Mw	Suited [1]	Suited [1]	Well suited [1]	Well suited [1]
For Gilford part of this mapping unit, see Gilford series.				
Nappanee: NaA, NaB, NpA, NpB2	Suited [1]	Suited [1]	Well suited [1]	Suited [1]
Oshtemo: OsA, OsB, OsC	Suited	Suited	Well suited	Suited
Owosso: OwA, OwB, OwC, OwC2	Well suited	Well suited	Well suited	Well suited
Paulding: Pa	Poorly suited [1]	Well suited [1]	Suited [1]	Well suited [1]
Pewamo: Pe, Pm	Well suited [1]	Well suited [1]	Well suited [1]	Well suited [1]
Pinconning: Pn	Suited [1]	Suited [1]	Well suited [1]	Well suited [1]
Richter: RcA, RcB	Suited	Suited	Well suited	Poorly suited
Roselms: RoA, RoB, RoB2	Suited [1]	Suited [1]	Well suited [1]	Suited
St. Clair: ScB2, ScC2	Suited	Suited	Well suited	Well suited
Sebewa: Se	Well suited [1]	Well suited [1]	Well suited [1]	Well suited [1]
Sisson: SfB, SfB2, SfC, SfC2	Well suited	Well suited	Well suited	Well suited
Sloan: Sn	Not suited [3]	Poorly suited [3]	Poorly suited [3]	Suited [3]
Spalding: So	Not suited	Not suited	Not suited	Not suited
For Greenwood part of this mapping unit, see Greenwood series.				
Spinks:				
SpA, SpB, SpC	Suited	Suited	Well suited	Suited
SpD	Poorly suited	Poorly suited	Well suited	Suited
SpE, SpF	Not suited	Not suited	Well suited	Suited
Tawas: Ta	Not suited [3]	Not suited	Poorly suited	Not suited
Tedrow: TeA, TeB	Suited	Suited	Well suited	Well suited
Tonkey: To	Well suited [1]	Well suited [1]	Well suited [1]	Well suited [1]
Tuscola: TuA, TuB	Well suited	Well suited	Well suited	Well suited
Ubly: UbA, UbB	Well suited	Well suited	Well suited	Well suited
Warners: Wb	Not suited	Not suited	Poorly suited	Not suited
Wasepi: WsA, WsB	Suited	Suited	Well suited	Well suited
Willette: Wt	Not suited	Not suited	Poorly suited	Not suited

[1] If soils are drained. If soils are not drained, the rating is lower.
[2] Most areas are questionable as sites for wildlife; onsite study is needed.

wildlife habitat and for kinds of wildlife—Continued

Elements of wildlife habitat—Continued				Kinds of wildlife		
Coniferous woody plants	Wetland food and cover plants	Shallow water developments	Excavated ponds	Openland wildlife	Woodland wildlife	Wetland wildlife
Poorly suited	Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Poorly suited	Not suited	Not suited	Not suited	Suited	Well suited	Not suited.
Poorly suited	Not suited	Not suited	Not suited	Poorly suited	Suited	Not suited.
Poorly suited	Suited	Suited	Suited	Well suited	Well suited	Suited.
Poorly suited	Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Poorly suited	Not suited	Not suited	Not suited	Suited	Well suited	Not suited.
Poorly suited	Not suited	Not suited	Not suited	Poorly suited	Suited	Not suited.
Poorly suited	Not suited	Not suited	Not suited	Well suited	Suited	Not suited.
Poorly suited	Not suited	Not suited	Not suited	Suited	Suited	Not suited.
Poorly suited	Suited	Suited	Suited	Well suited	Suited	Suited.
Poorly suited	Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Poorly suited	Not suited	Not suited	Not suited	Suited	Well suited	Not suited.
Poorly suited	Not suited	Not suited	Not suited	Poorly suited	Suited	Not suited.
Poorly suited	Not suited	Not suited	Not suited	Well suited	Suited	Not suited.
Poorly suited	Not suited	Not suited	Not suited	Suited	Suited	Not suited.
Poorly suited	Not suited	Not suited	Not suited	Poorly suited	Poorly suited	Not suited.
Poorly suited	Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Poorly suited	Not suited	Not suited	Not suited	Suited	Well suited	Not suited.
Poorly suited	Not suited	Not suited	Not suited	Poorly suited	Suited	Not suited.
Well suited	Suited	Well suited	Well suited	Well suited [1]	Well suited	Well suited.
Suited	Well suited	Well suited	Well suited	Well suited [1]	Well suited [1]	Well suited.
Poorly suited	Suited	Suited	Suited	Well suited [1]	Suited	Suited.
Poorly suited	Not suited	Not suited	Not suited	Well suited	Suited	Not suited.
Poorly suited	Not suited	Not suited	Not suited	Poorly suited	Suited	Not suited.
Suited	Well suited	Well suited	Well suited	Suited [1]	Well suited [1]	Well suited.
Suited	Well suited	Well suited	Well suited	Well suited [1]	Well suited [1]	Well suited.
Suited	Well suited	Well suited	Well suited	Well suited [1]	Well suited [1]	Well suited.
Poorly suited	Suited	Suited	Suited	Well suited	Well suited	Suited.
Poorly suited	Suited	Suited	Suited	Well suited [1]	Suited	Suited.
Poorly suited	Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Suited	Well suited	Well suited	Well suited	Well suited [1]	Well suited [1]	Well suited.
Poorly suited	Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Well suited	Well suited	Well suited	Well suited	Not suited [3]	Suited	Well suited.
Not suited	Well suited	Well suited	Well suited	Not suited	Not suited	Suited.
Poorly suited	Not suited	Not suited	Not suited	Well suited	Suited	Not suited.
Poorly suited	Not suited	Not suited	Not suited	Suited	Suited	Not suited.
Poorly suited	Not suited	Not suited	Not suited	Poorly suited	Poorly suited	Not suited.
Not suited	Well suited	Well suited	Well suited	Not suited	Not suited	Suited.
Poorly suited	Suited	Suited	Suited	Well suited	Suited	Suited.
Poorly suited	Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Poorly suited	Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Not suited	Well suited	Well suited	Well suited	Not suited	Not suited	Suited.
Poorly suited	Suited	Suited	Suited	Well suited	Suited	Suited.
Not suited	Well suited	Well suited	Well suited	Not suited	Not suited	Suited.

[3] If soils are not drained. If soils are drained, the rating is higher.

TABLE 4.—*Engineering*

[Tests performed by the Bureau of Public Roads in accordance with standard

Soil and location of sample	Parent material	Bureau of Public Roads report No.	Depth from surface	Mechanical analysis [1]		
				Percentage passing sieve—		
				3/4-in.	3/8-in.	No. 4 (4.7 mm.)
			Inches			
Chelsea loamy sand:						
SE¼SE¼SE¼SW¼ sec. 23, T. 9 N., R. 11 E.	Glacial drift.	S-40931	8–18	100	99	98
		S-40932	18–36	----------	----------	----------
		S-40933	36–60	----------	----------	----------
		S-40934	60–84	----------	----------	----------
SW¼NW¼SE¼SE¼ sec. 21, T. 9 N., R. 10 E.	Glacial drift.	S-40935	4–28	----------	----------	----------
		S-40936	28–56	----------	----------	----------
		S-40937	56–98	----------	----------	----------
		S-40938	98–136	----------	----------	----------
		S-40939	136	100	98	91
NW¼NW¼SW¼SE¼ sec. 9, T. 9 N., R. 10 E.	Terrace deposits.	S-40940	9–25	----------	100	99
		S-40941	25–38	----------	----------	----------
		S-40942	38–96	----------	100	99
Lapeer sandy loam:						
SW¼NW¼ sec. 30, T. 7 N., R. 11 E.	Wisconsin glacial till.	S-40952	0–8	95	94	93
		S-40953	28–40	100	99	99
		S-40954	40	----------	100	99
SE¼NW¼NW¼NE¼ sec. 4, T. 6 N., R. 10 E.	Wisconsin glacial till.	S-40955	0–9	96	93	91
		S-40956	17–26	97	95	93
		S-40957	26–45	97	93	89
		S-40958	45	96	93	89
NE¼NE¼ sec. 21, T. 6 N., R. 10 E.	Wisconsin glacial till.	S-40959	0–7	97	94	91
		S-40960	26–34	98	96	94
		S-40961	34	98	95	91
Roselms clay loam:						
NE¼NE¼ sec. 13, T. 10 N., R. 10 E.	Lacustrine clay of glacial Lake Silverwood.	S-40943	0–7	----------	----------	----------
		S-40944	8–16	----------	----------	----------
		S-40945	21	----------	----------	----------
NE¼NW¼ sec. 12, T. 10 N., R. 10 E.	Lacustrine clay of glacial Lake Silverwood.	S-40946	0–9	----------	100	99
		S-40947	10–20	----------	----------	----------
		S-40948	28	----------	----------	----------
NW¼NW¼ sec. 30, T. 10 N., R. 11 E.	Lacustrine clay of glacial Lake Silverwood.	S-40949	0–7	----------	----------	----------
		S-40950	8–16	----------	----------	----------
		S-40951	24	----------	----------	----------

[1] Mechanical analysis according to AASHO Designation: T 88 (*1*). Results obtained by this procedure may differ from results obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO procedure, the fine material is analyzed by the hydrometer method and the various grain-size fractions are calculated on the basis of all the material, including that more than 2 millimeters in diameter. In the SCS procedure, the fine material is analyzed by the pipette method and the material more than 2 millimeters in diameter is excluded from calculations of grain-size fractions. The mechanical analysis data used in this table are not suitable for use in naming the textural classes of the soils.

test data

procedures of the American Association of State Highway Officials (AASHO)]

Mechanical analysis [1]—Continued							Liquid limit	Plasticity index	Classification	
Percentage passing sieve—Continued			Percentage smaller than—						AASHO	Unified [2]
No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	0.05 mm.	0.02 mm.	0.005 mm.	0.002 mm.				
							Percent			
96	79	11	10	9	7	6	[3] NP	[3] NP	A–2–4(0)	SP–SM
100	91	9	8	6	5	5	NP	NP	A–3(0)	SP–SM
100	98	6	5	5	3	3	NP	NP	A–3(0)	SP–SM
100	96	4	4	4	4	4	NP	NP	A–3(0)	SP
100	82	10	9	7	4	3	NP	NP	A–3(0)	SP–SM
100	81	11	9	7	4	3	NP	NP	A–2–4(0)	SP–SM
100	82	5	4	4	3	3	NP	NP	A–3(0)	SP–SM
100	82	3	2	2	2	1	NP	NP	A–3(0)	SP
81	66	3	3	3	3	3	NP	NP	A–3(0)	SP
98	93	17	11	10	7	6	NP	NP	A–2–4(0)	SM
100	99	7	4	3	3	2	NP	NP	A–3(0)	SP–SM
97	91	9	6	4	3	3	NP	NP	A–3(0)	SP–SM
92	88	40	35	22	10	6	NP	NP	A–4(1)	SM
98	95	55	49	33	22	18	25	12	A–6(5)	CL
98	96	64	54	32	16	12	17	3	A–4(6)	ML
89	78	28	24	17	8	4	NP	NP	A–2–4(0)	SM
90	79	35	32	23	17	14	22	10	A–2–4(0)	SC
86	71	27	23	17	9	6	NP	NP	A–2–4(0)	SM
83	62	17	15	12	7	5	NP	NP	A–2–4(0)	SM
88	79	38	32	26	15	11	18	4	A–4(1)	SM–SC
91	82	47	44	36	26	20	30	16	A–6(4)	SC
86	75	42	39	28	16	11	17	5	A–4(1)	SM–SC
100	98	82	76	58	40	28	41	16	A–7–6(10)	ML–CL
100	99	88	84	78	64	50	49	27	A–7–6(17)	CL
----------	----------	99	99	95	88	70	55	29	A–7–6(19)	CH
97	92	64	59	50	36	26	36	15	A–6(10)	CL
100	99	92	91	89	83	66	62	36	A–7–6(20)	CH
100	99	97	97	94	86	63	55	30	A–7–6(19)	CH
100	96	77	71	55	42	31	37	16	A–6(10)	CL
100	99	88	85	78	70	58	60	35	A–7–6(20)	CH
----------	----------	100	99	97	89	72	61	34	A–7–6(20)	CH

[2] The Soil Conservation Service and the Bureau of Public Roads have agreed that any soil that has a plasticity index within two points of the A-line is to be given a borderline classification. SP–SM is an example of such a borderline classification.

[3] NP=Nonplastic.

TABLE 5.—*Estimated engineering*

Soil series and map symbols	Depth to seasonal high water table [1]	Depth from surface	Classification: USDA texture
	Ft.	*In.*	
Abscota: Ab	[2] 2–3	0–28	Loamy sand
		28–42	Stratified loamy sand and sand
Adrian: Ad	0	0–30	Muck and peat
		30–42	Sand
Alcona: AlA, AlB, AlC	4+	0–9	Sandy loam
		9–26	Sandy loam and heavy sandy loam
		26–65	Stratified sandy loam and loamy fine sand
Algansee: An	[2] 1–2	0–12	Sandy loam
		12–42	Loamy sand and sand
Allendale: AoA, AoB	1–2	0–26	Loamy sand
		26–33	Gravelly loam
		33–42	Clay
Au Gres:			
AsB	1–2	0–11	Loamy sand
		11–42	Sand
AuA	1–2	0–9	Loamy sand
		9–59	Sand
		59–66	Silty clay loam
Barry: Ba	<1	0–16	Loam
		16–24	Sandy clay loam
		24–48	Sandy loam
Belding: BeA, BeB	1–2	0–23	Sandy loam
		23–36	Loam
		36–60	Clay loam
Belding, clay subsoil variant: BfA, BfB	1–2	0–24	Sandy loam
		24–30	Loam
		30–42	Clay
Berville: Bh	<1	0–16	Loam, gravelly loam
		16–30	Gravelly sandy clay loam
		30–40	Gravelly clay loam
		40–60	Loam
Blount: BlA, BlB, BlB2	1–2	0–8	Loam
		8–28	Heavy silty clay loam, clay loam
		28–42	Clay loam
Borrow pits: Bp. All properties variable.			
Boyer: BrA, BrB, BrC, BrD, BrE, BrF, BsA, BsB, BsC, BsD.	4+	0–15	Loamy sand
		15–24	Sandy loam
		24–30	Gravelly sandy clay loam
		30–48	Stratified sand and gravel
Brady: BtA, BtB	1–2	0–22	Loamy sand
		22–48	Sandy loam
		48–60	Stratified sand and gravel
Breckenridge: Bu	<1	0–27	Sandy loam
		27–42	Silty clay loam
Brevort: Bv	<1	0–22	Loamy sand and loamy fine sand
		22–28	Sandy loam
		28–34	Sand and gravel
		34–44	Clay loam
Brookston: Bw	<1	0–12	Loam
		12–38	Clay loam
		38–48	Loam

See footnotes at end of table.

properties of the soils

Classification—Continued		Percentage passing sieve—			Permeability	Available water capacity	Reaction	Shrink-swell potential
Unified	AASHO	No. 4	No. 10	No. 200				
					In./hr.	*In./in.*	*pH*	
SM	A–2	100	95–100	15–30	5. 0–10. 0	0. 05	6. 1–7. 8	Low.
SM	A–2	100	95–100	10–20	5. 0–10. 0	. 04	(3)	Low.
Pt					5. 0–10. 0	. 25	6. 6–7. 3	Variable.
SP	A–3	100	100	0–5	>10. 0	. 04	7. 4–7. 8	Low.
SM	A–2 or A–4	100	95–100	25–40	2. 5–5. 0	. 10	6. 1–6. 5	Low.
SM	A–2 or A–4	100	95–100	30–45	0. 8–2. 5	. 12	5. 6–6. 0	Low.
SM	A–2 or A–4	100	95–100	20–40	2. 5–10. 0	. 09	6. 1–6. 5	Low.
SM	A–2	100	95–100	25–35	2. 5–10. 0	. 10	6. 6–7. 3	Low.
SP–SM or SM	A–2	100	95–100	10–20	5. 0–10. 0	. 04	[3] 6. 6–7. 8	Low.
SM	A–2	100	100	15–25	5. 0–10. 0	. 06	5. 6–7. 3	Low.
ML	A–4	70–85	70–80	55–70	0. 8–5. 0	. 14	7. 4–7. 8	Low.
CH	A–7	100	100	85–95	<0. 05	. 18	(3)	High.
SM	A–2	100	95–100	15–30	5. 0–10. 0	. 06	6. 1–6. 5	Low.
SP or SP–SM	A–3	100	95–100	0–10	5. 0–10. 0	. 03	5. 6–6. 0	Low.
SM	A–2	100	95–100	15–25	5. 0–10. 0	. 06	5. 6–6. 0	Low.
SP or SP–SM	A–3	100	95–100	0–10	>10. 0	. 04	5. 6–6. 0	Low.
CL	A–7	100	95–100	80–90	0. 2–0. 8	. 18	7. 4–7. 8	Moderate.
ML	A–4	95–100	90–100	60–75	0. 8–2. 5	. 17	6. 6–7. 3	Low.
SC	A–2 or A–6	95–100	90–100	30–40	0. 8–2. 5	. 16	6. 6–7. 3	Low to moderate.
SM	A–2	95–100	90–100	25–35	2. 5–5. 0	. 10	[3] 7. 4–7. 8	Low.
SM	A–2 or A–4	95–100	90–100	30–40	2. 5–5. 0	. 13	5. 6–6. 5	Low.
ML	A–4	95–100	90–100	55–70	0. 8–2. 5	. 16	5. 6–6. 0	Low.
CL	A–6 or A–7	95–100	95–100	70–80	0. 2–2. 5	. 16	[3] 6. 6–7. 3	Moderate.
SM	A–2	100	95–100	15–35	2. 5–10. 0	. 12	6. 1–7. 3	Low.
ML	A–4	95–100	90–100	60–70	0. 8–2. 5	. 16	7. 4–7. 8	Low.
CH	A–7	100	100	80–100	0. 05–0. 2	. 16	(3)	High.
ML	A–4	100	95–100	60–70	0. 8–2. 5	. 16	6. 1–7. 3	Low.
SC	A–2 or A–6	60–90	50–80	25–45	0. 8–2. 5	. 16	7. 4–7. 8	Moderate to low.
CL	A–6	70–85	70–80	55–70	0. 2–0. 8	. 18	7. 4–7. 8	Moderate.
ML	A–4	100	95–100	60–70	0. 8–2. 5	. 14	(3)	Low.
ML	A–4	100	100	60–75	0. 8–2. 5	. 16	5. 6–6. 5	Low.
CL	A–6 or A–7	100	100	75–95	0. 2–0. 8	. 20	5. 6–7. 3	Moderate.
CL	A–6 or A–7	100	95–100	70–80	0. 2–0. 8	. 17	(3)	Moderate.
SM	A–2	95–100	90–100	15–30	2. 5–10. 0	. 10	5. 6–6. 5	Low.
SM	A–2	95–100	90–100	25–35	2. 5–5. 0	. 12	5. 6–6. 0	Low.
SC	A–6	70–85	65–80	35–45	2. 5–5. 0	. 16	6. 1–6. 5	Moderate.
SP or SP–SM	A–1	55–80	50–70	0–10	>10. 0	. 03	(3)	Low.
SM	A–2	95–100	90–95	15–30	2. 5–10. 0	. 10	5. 6–6. 0	Low.
SM or SC	A–2 or A–6	95–100	90–95	30–45	0. 8–2. 5	. 12	5. 6–6. 5	Low.
SP or GP	A–1	35–75	30–70	0–5	>10. 0	. 02	(3)	Low.
SM	A–2 or A–4	100	90–100	25–45	2. 5–5. 0	. 12	7. 4–7. 8	Low.
CL	A–7	100	95–100	80–90	0. 2–0. 8	. 18	(3)	Moderate.
SM	A–2	100	95–100	15–25	5. 0–10. 0	. 06	6. 1–7. 3	Low.
SM	A–2	100	95–100	25–35	2. 5–5. 0	. 12	7. 4–7. 8	Low.
SP or GP	A–1	40–75	35–70	0–5	>10. 0	. 02	(3)	Low.
CL	A–6 or A–7	100	90–100	70–80	0. 8–2. 5	. 16	(3)	Moderate.
ML	A–4	100	95–100	60–75	0. 8–2. 5	. 17	6. 1–6. 5	Low.
CL	A–6	100	95–100	60–80	0. 2–0. 8	. 17	6. 6–7. 3	Moderate.
ML	A–4	95–100	90–100	55–75	0. 8–2. 5	. 16	(3)	Low.

TABLE 5.—*Estimated engineering*

Soil series and map symbols	Depth to seasonal high water table [1]	Depth from surface	Classification: USDA texture
	Ft.	*In.*	
Capac: CaA, CaB	1–2	0–12	Fine sandy loam, sandy loam
		12–34	Clay loam
		34–48	Loam
Carlisle: Cc	0	0–44	Muck
Celina: CeA, CeB, CeB2	2–3	0–12	Loam
		12–24	Clay loam
		24–42	Heavy loam
Ceresco: Cf	[2] 1–2	0–9	Loam
		9–26	Sandy loam
		26–42	Stratified sandy loam and loamy fine sand
Chelsea: ChB, ChC, ChD	4+	0–8	Loamy sand
		8–44	Sand
		44–84	Sand and thin bands of loamy sand
Cohoctah: Cm	[2] <1	0–8	Loam
		8–28	Fine sandy loam
		28–50	Heavy loamy fine sand
Colwood: Co	<1	0–18	Loam
		18–32	Light silty clay loam
		32–48	Stratified silt loam, silt, fine sand, and very fine sand
Conover: CvA, CvB	1–2	0–11	Loam
		11–28	Clay loam
		28–42	Loam
Del Rey: DrA, DrB	1–2	0–8	Silt loam
		8–24	Silty clay loam
		24–42	Stratified silty clay loam and silt; thin strata of very fine sand.
Dryden: DyA, DyB	3–2	0–12	Sandy loam
		12–21	Heavy loam
		21–34	Sandy clay loam
		34–42	Sandy loam
Edwards: Ed	0	0–30	Muck
		30–54	Marl
Fabius: FaA, FaB	1–2	0–12	Sandy loam
For properties of Wasepi part of these mapping units, see Wasepi series.		12–18	Gravelly sandy clay loam
		18–42	Sand and gravel
Fox: FoA, FoB, FoC2	3+	0–8	Sandy loam
		8–30	Gravelly sandy clay loam and sandy loam
		30–42	Stratified gravel and sand
Gilford: Gd	<1	0–15	Sandy loam
		15–30	Sandy loam
		30–42	Sand and gravel
Glendora: Ge	[2] <1	0–8	Loam
		8–15	Loamy sand
		15–42	Sand
Granby: Gm, Gn	<1	0–14	Loamy sand
		14–40	Sand
Gravel pits: Gr. All properties variable.			
Greenwood	0	0–42	Peat
Mapped only with Spalding soils.			

See footnotes at end of table.

properties of the soils—Continued

Classification—Continued		Percentage passing sieve—			Permeability	Available water capacity	Reaction	Shrink-swell potential
Unified	AASHO	No. 4	No. 10	No. 200				
					In./hr.	*In./in.*	*pH*	
SM	A–4, A–2	100	90–100	25–50	2. 5–5. 0	. 14	5. 1–6. 5	Low.
CL	A–6	100	95–100	70–80	0. 2–0. 8	. 18	6. 6–7. 8	Moderate.
ML	A–4	100	95–100	60–70	0. 8–2. 5	. 16	(3)	Low.
Pt					5. 0–10. 0	. 50	6. 1–6. 5	Variable.
ML	A–4	95–100	90–100	55–75	0. 08–2. 5	. 17	5. 1–6. 5	Low.
CL	A–6	100	95–100	65–85	0. 2–0. 8	. 17	5. 1–6. 5	Moderate.
ML	A–4	95–100	90–100	55–75	0. 08–2. 5	. 16	(3)	Low.
ML	A–4	100	95–100	55–75	0. 8–2. 5	. 16	6. 6–7. 8	Low.
SM	A–2	100	95–100	15–35	2. 5–10. 0	. 10	6. 6–7. 8	Low.
SM	A–2	100	100	15–35	2. 5–10. 0	. 10	3 7. 4–7. 8	Low.
SM	A–2	100	95–100	10–20	5. 0–10. 0	. 05	7. 4–7. 8	Low.
SP–SM	A–3	100	95–100	5–15	5. 0–10. 0	. 03	5. 6–6. 0	Low.
SP and SP–SM	A–3	90–100	80–100	0–10	5. 0–10. 0	. 04	5. 6–6. 0	Low.
ML	A–4	100	95–100	55–75	0. 8–2. 5	. 17	6. 6–7. 3	Low.
SM or ML	A–4	100	95–100	40–60	0. 8–5. 0	. 15	7. 4–7. 8	Low.
SM	A–2	100	95–100	20–35	5. 0–10. 0	. 07	7. 4–7. 8	Low.
ML	A–4	100	95–100	55–75	0. 8–2. 5	. 17	6. 6–7. 3	Low.
ML	A–4	100	95–100	80–95	0. 2–0. 8	. 20	7. 4–7. 8	Low.
ML	A–4	100	100	60–80	0. 8–2. 5	. 20	(3)	Low.
ML	A–4	100	95–100	60–75	0. 8–2. 5	. 17	5. 6–7. 3	Low.
CL	A–6	100	95–100	60-80	0. 2–0. 8	. 17	6. 1–7. 3	Moderate.
ML	A–4	95–100	90–100	55–75	0. 8–2. 5	. 16	(3)	Low.
ML	A–4	100	100	80–90	0. 8–2. 5	. 21	6. 6–7. 3	Low.
CL	A–7	100	100	90–95	0. 2–0. 8	. 20	7. 4–7. 8	Moderate.
CL	A–6 or A–7	100	95–100	80–90	0. 05–0. 2	. 20	(3)	Moderate.
SM	A–2 or A–4	95–100	90–100	30–40	2. 5–5. 0	. 12	5. 6–6. 5	Low.
ML	A–4	100	95–100	60–75	0. 8–2. 5	. 16	6. 1–6. 5	Low.
SC	A–2 or A–6	95–100	90–100	30–45	0. 8–2. 5	. 16	6. 1–6. 5	Low to moderate.
SM	A–2	85–95	80–90	20–30	2. 5–5. 0	. 12	(3)	Low.
Pt					5. 0–10. 0	. 25	3 7. 4–7. 8 (3)	Variable.
SM	A–2 or A–4	95–100	90–100	30–40	2. 5–5. 0	. 12	6. 1–6. 5	Low.
SC	A–2 or A–6	70–85	65–80	30–45	2. 5–5. 0	. 16	6. 1–6. 5	Low to moderate.
SP, SW, or SP–SM	A–1	55–80	50–70	0–10	5. 0–10. 0	. 03	(3)	Low.
SM	A–2 or A–4	95–100	90–100	30–40	2. 5–5. 0	. 12	6. 6–7. 3	Low.
SC	A–2 or A–6	70–85	65–80	25–45	0. 8–2. 5	. 16	5. 6–6. 5	Low to moderate.
SP or SP–SM	A–1	55–80	50–70	0–10	5. 0–10. 0	. 03	(3)	Low.
SM	A–2	95–100	90–100	20–35	2. 5–10. 0	. 13	6. 1–6. 5	Low.
SM	A–2	100	95–100	30–45	2. 5–5. 0	. 12	6. 6–7. 3	Low.
SP, SW, or SP–SM	A–1	55–80	50–70	0–10	5. 0–10. 0	. 04	3 7. 4–7. 8	Low.
ML	A–4	100	95–100	55–65	0. 8–2. 5	. 17	6. 1–6. 5	Low.
SM	A–2–4	100	95–100	10–20	5. 0–10. 0	. 04	6. 1–7. 3	Low.
SP	A–1 or A–3	95–100	95–100	0–5	>10. 0	. 03	6. 6–7. 3	Low.
SM	A–2	100	95–100	15–30	5. 0–10. 0	. 05	6. 1–7. 3	Low.
SP	A–3	100	95–100	0–5	5. 0–10. 0	. 03	6. 6–7. 3	Low.
Pt					5. 0–10. 0	. 25	<4. 5	Variable.

TABLE 5.—*Estimated engineering*

Soil series and map symbols	Depth to seasonal high water table [1]	Depth from surface	Classification: USDA texture
	Ft.	*In.*	
Gullied land: Gs, Gu. All properties variable.			
Houghton: Ho	0	0–46	Muck and peat
Hoytville: Ht, Hy	<1	0–9	Silt loam
		9–42	Clay
Iosco: IoA	1–2	0–14	Loamy sand
		14–30	Sand
		30–42	Silty clay loam
Kibbie: KbA, KbB	1–2	0–11	Loam
		11–19	Heavy silt loam
		19–34	Light silty clay loam
		34–42	Stratified silt, fine sand, and very fine sand
Lapeer: LaA, LaB, LaB2, LaC, LaC2, LaC3, LaD2, LaD3, LaE2, LaE3, LaF.	3+	0–16	Sandy loam
		16–22	Heavy sandy loam
		22–36	Heavy loam and sandy clay loam
		36–48	Sandy loam
Lenawee: Le	<1	0–14	Silty clay loam
		14–34	Heavy silty clay loam
		34–42	Stratified silty clay loam, clay loam, silt, and fine sand
Linwood: Lm	0	0–36	Muck
		36–42	Silt loam
Locke: LoA, LoB	1–2	0–17	Sandy loam
		17–30	Sandy clay loam
		30–42	Sandy loam
Lupton: Lu	0	0–48	Muck and peat
Macomb: MaA, MaB	1–2	0–11	Sandy loam
		11–30	Heavy loam and gravelly clay loam
		30–42	Loam
Made land: Md. All properties variable.			
Mancelona: MeB, MeC2	3+	0–48	Loamy sand and gravelly loamy sand
		48–60	Silty clay loam
Marlette: MfA, MfB, MfB2, MfC, MfC2, MfC3, MfD2, MfD3, MfE2, MfF2.	3+	0–18	Sandy loam
		18–31	Clay loam
		31–48	Loam
Matherton: MhA, MhB	1–2	0–12	Loam
		12–34	Gravelly clay loam
		34–42	Stratified gravel and sand
McBride: MkB, MkB2, MkC2, MlA, MlB, MlB2, MlC, MlC2, MlC3, MlD, MlD2, MlD3, MlE2, MlF.	3+	0–30	Sandy loam
		30–55	Sandy clay loam and loam
		55–60	Sandy loam
Menominee: MmA, MmB, MmC, MmD	3+	0–22	Loamy sand and sand
		22–29	Clay loam
		29–42	Loam
Metamora: MnA, MnB	1–2	0–26	Sandy loam
		26–32	Light loam
		32–48	Clay loam
		48–60	Loam

See footnotes at end of table.

properties of the soils—Continued

Classification—Continued		Percentage passing sieve—			Permeability	Available water capacity	Reaction	Shrink-swell potential
Unified	AASHO	No. 4	No. 10	No. 200				
					In./hr.	*In./in.*	*pH*	
Pt					5. 0–10. 0	. 25	5. 6–7. 3	Variable.
ML	A–4	100	100	70–90	0. 8–2. 5	. 21	6. 1–6. 5	Low.
CH	A–7	100	100	80–95	<0. 05	. 16	[3] 6. 1–7. 3	High.
SM	A–2	100	100	15–25	5. 0–10. 0	. 06	5. 6–6. 0	Low.
SP	A–3	100	100	0–5	10. 0	. 04	5. 6–6. 0	Low.
CL	A–6 or A–7	100	95–100	70–90	0. 2–0. 8	. 16	[3] 7. 4–7. 8	Low to moderate.
ML	A–4	100	95–100	55–75	0. 8–2. 5	. 16	6. 1–6. 5	Low.
ML	A–4	100	95–100	70–90	0. 8–2. 5	. 16	6. 1–6. 5	Low.
CL	A–6 or A–7	100	95–100	80–95	0. 2–0. 8	. 20	6. 6–7. 3	Moderate.
ML and SM, in layers	A–4 and A–2, in layers	100	95–100	30–70	0. 8–2. 5	. 18	(3)	Low.
SM	A–2–4	90–95	85–95	25–45	2. 5–5. 0	. 12	6. 1–6. 5	Low.
SM	A–4	90–95	85–95	30–45	0. 8–2. 5	. 14	6. 1–6. 5	Low.
CL or SC	A–4 or A–6	85–100	80–100	35–65	0. 8–2. 5	. 16	6. 1–7. 3	Low.
SM	A–2–4	85–100	80–100	20–45	2. 5–5. 0	. 12	(3)	Low.
CL	A–6	100	100	80–90	0. 2–0. 8	. 21	6. 1–6. 5	Moderate.
CL	A–7	100	100	85–95	0. 2–0. 8	. 20	7. 4–7. 8	Moderate.
CL	A–6 or A–7	100	95–100	40–90	0. 2–0. 8	. 19	(3)	Moderate.
Pt					5. 0–10. 0	. 25	6. 1–7. 3	Variable.
ML	A–4	100	95–100	60–90	0. 2–2. 5	. 19	7. 4–7. 8	Low.
SM	A–2 or A–4	95–100	90–100	25–40	2. 5–5. 0	. 13	5. 6–6. 5	Low.
SC	A–2 or A–6	95–100	90–100	30–45	0. 8–2. 5	. 16	6. 1–6. 5	Low to moderate.
SM	A–2	85–95	80–90	20–30	0. 8–2. 5	. 12	(3)	Low.
Pt					5. 0–10. 0	. 25	7. 4–7. 8	Variable.
SM	A–2 or A–4	95–100	90–100	30–40	2. 5–5. 0	. 12	5. 6–6. 5	Low.
ML–CL	A–6	70–85	65–80	60–80	0. 8–2. 5	. 16	5. 6–6. 5	Low.
ML	A–4	95–100	90–100	55–75	0. 8–2. 5	. 16	(3)	Low.
SM	A–2	70–85	65–80	15–25	5. 0–10. 0	. 06	5. 6–6. 5	Low.
CL	A–6 or A–7	100	95–100	80–90	0. 2–0. 8	. 18	(3)	Moderate.
SM	A–2	100	90–100	25–35	2. 5–5. 0	. 14	5. 6–6. 5	Low.
CL	A–6 or A–7	100	95–100	70–80	0. 2–0. 8	. 18	6. 1–6. 5	Moderate.
ML	A–4	100	95–100	60–70	0. 8–2. 5	. 16	(3)	Low.
ML	A–4	95–100	90–100	55–75	0. 8–2. 5	. 17	6. 1–6. 5	Low.
CL	A–6 or A–7	70–85	65–80	60–80	0. 8–2. 5	. 16	5. 6–6. 0	Low to moderate.
SP or SP–SM	A–1	55–80	50–70	0–10	>10. 0	. 03	(3)	Low.
SM	A–2	100	90–100	25–35	2. 5–5. 0	. 14	5. 1–6. 5	Low.
SC, ML	A–4 or A–6	100	95–100	40–70	2. 5–5. 0	. 16	5. 1–5. 5	Low.
SM	A–2	100	90–100	25–35	2. 5–5. 0	. 12	(3)	Low.
SM	A–2	100	95–100	10–30	5. 0–10. 0	. 05	5. 6–6. 5	Low.
CL	A–6 or A–7	100	95–100	60–80	0. 2–0. 8	. 17	7. 4–7. 8	Moderate.
ML	A–4	95–100	90–100	55–75	0. 8–2. 5	. 16	(3)	Low.
SM	A–2	100	95–100	20–35	2. 5–5. 0	. 12	5. 6–6. 0	Low.
ML	A–4	95–100	90–100	55–75	0. 8–2. 5	. 16	5. 6–6. 0	Low.
CL	A–6 or A–7	95–100	90–100	65–80	0. 2–0. 8	. 18	6. 1–6. 5	Moderate.
ML	A–4	95–100	90–100	55–75	0. 8–2. 5	. 16	(3)	Low.

TABLE 5.—*Estimated engineering*

Soil series and map symbols	Depth to seasonal high water table [1]	Depth from surface	Classification: USDA texture
	Ft.	*In.*	
Miami: MoB, MoB2, MoC, MoC2, MoD, MoD2, MoE, MoE2, MoF, MoF2, MpC3, MpD3, MpE3, MpF3.	3+	0–12	Loam
		12–36	Clay loam
		36–48	Loam
Montcalm: MrA, MrB, MrC, MrD, MrE, MrF, MsA, MsB.	4+	0–22	Loamy sand
		22–29	Sandy loam
		29–54	Loamy sand and sand; bands of fine sandy loam and loamy fine sand.
		54–60	Fine sand
Morley: MtB, MtB2, MtC, MtC2, MtD2, MuC3, MuD3, MuE3.	2–3	0–10	Loam
		10–27	Heavy clay loam, clay
		27–42	Clay loam
Munuscong: Mv	<1	0–30	Sandy loam
		30–42	Clay
Mussey: Mw	<1	0–9	Sandy loam
For properties of Gilford part of this mapping unit, see Gilford series.		9–18	Loam and gravelly clay loam
		18–42	Stratified sand and gravel
Nappanee: NaA, NaB, NpA, NpB [2]	1–2	0–8	Loam
		8–28	Clay
		28–42	Clay
Oshtemo: OsA, OsB, OsC	4+	0–8	Sandy loam
		8–20	Loamy sand
		20–36	Sandy loam
		36–52	Loamy sand
		52–72	Stratified sand and fine gravel
Owosso: OwA, OwB, OwC, OwC2	3+	0–25	Sandy loam
		25–31	Clay loam
		31–42	Loam
Paulding: Pa	<1	0–8	Clay
		8–42	Clay
Pewamo: Pe, Pm	<1	0–11	Loam
		11–34	Clay loam, clay
		34–48	Clay loam
Pinconning: Pn	<1	0–22	Loamy sand
		22–34	Sand
		34–60	Clay
Richter: RcA, RcB	1–2	0–12	Sandy loam
		12–19	Fine sandy loam
		19–32	Stratified heavy sandy loam and silt
		32–42	Stratified sandy loam, fine sandy loam, loamy sand, and fine gravel.
Roselms: RoA, RoB, RoB2	1–2	0–7	Clay loam
		7–23	Clay
		23–42	Clay
St. Clair: ScB2, ScC2	2–3	0–8	Silty clay loam
		8–42	Clay
Sebewa: Se	<1	0–10	Loam
		10–34	Gravelly clay loam
		34–42	Stratified gravel and sand

See footnotes at end of table.

properties of the soils—Continued

Classification—Continued		Percentage passing sieve—			Permeability	Available water capacity	Reaction	Shrink-swell potential
Unified	AASHO	No. 4	No. 10	No. 200				
					In./hr.	*In./in.*	*pH*	
ML	A–4	95–100	90–100	55–75	0. 8–2. 5	. 16	5. 6–6. 5	Low.
CL	A–6 or A–7	100	95–100	60–80	0. 2–0. 8	. 17	5. 6–6. 5	Moderate.
ML	A–4	95–100	90–100	55–75	0. 8–2. 5	. 16	(3)	Low.
SM	A–2	100	100	15–25	5. 0–10. 0	. 06	5. 6–6. 0	Low.
SM	A–2	100	95–100	20–35	2. 5–5. 0	. 12	6. 1–6. 5	Low.
SM	A–2	100	95–100	15–35	2. 5–5. 0	. 10	6. 1–7. 3	Low.
SP or SM	A–3 or A–2	100	100	0–15	>10. 0	. 04	(3)	Low.
ML or ML–CL	A–4	95–100	90–100	60–75	0. 8–2. 5	. 16	5. 6–6. 0	Low.
CL or CH	A–6 or A–7	100	95–100	70–95	0. 2–0. 8	. 18	5. 6–6. 5	Moderate to high.
CL	A–6 or A–7	95–100	90–100	70–95	0. 2–0. 8	. 18	(3)	Moderate.
SM	A–2	100	90–100	25–35	2. 5–5. 0	. 14	6. 1–7. 8	Low.
CH	A–7	100	95–100	85–95	0. 05–0. 2	. 18	(3)	High.
SM	A–2	100	95–100	20–35	0. 8–2. 5	. 14	6. 6–7. 3	Low.
ML–CL	A–6	70–85	65–80	60–80	0. 8–2. 5	. 16	6. 6–7. 3	Moderate.
SP or SP–SM	A–1	55–80	50–70	0–10	>10. 0	. 03	(3)	Low.
ML or ML–CL	A–4	100	95–100	55–75	0. 8–2. 5	. 19	5. 6–6. 0	Low.
CH	A–7	100	95–100	80–95	<0. 05	. 16	5. 6–7. 8	High.
CH	A–7	100	95–100	80–95	<0. 05	. 16	7. 4–7. 8	High.
SM	A–2	100	95–100	15–35	2. 5–10. 0	. 12	5. 6–6. 0	Low.
SM	A–2	100	95–100	15–25	2. 5–10. 0	. 06	5. 1–5. 5	Low.
SM, SC	A–2 or A–6	95–100	90–100	30–45	2. 5–5. 0	. 12	5. 1–6. 0	Low.
SM	A–2	90–100	85–95	10–25	5. 0–10. 0	. 04	5. 6–6. 0	Low.
SP or SP–SM	A–1	55–75	50–70	0–10	>10. 0	. 03	(3)	Low.
SM	A–2	100	90–100	25–35	2. 5–5. 0	. 14	5. 6–6. 5	Low.
CL	A–6 or A–7	100	95–100	60–80	0. 2–0. 8	. 17	6. 6–7. 3	Moderate.
ML	A–4	95–100	90–100	55–75	0. 8–2. 5	. 16	(3)	Low.
CH	A–7	100	100	80–100	0. 05–0. 2	. 21	6. 1–6. 5	High.
CH	A–7	100	100	80–100	<0. 05	. 16	[3] 6. 1–7. 8	High.
ML	A–4	100	95–100	55–75	0. 8–2. 5	. 17	6. 1–6. 5	Low.
CL or CH	A–6 or A–7	100	95–100	70–95	0. 2–0. 8	. 18	6. 1–7. 8	Moderate to high.
CL	A–6 or A–7	100	95–100	60–80	0. 2–0. 8	. 17	(3)	Moderate.
SM	A–2	100	100	15–25	2. 5–5. 0	. 06	6. 5–7. 8	Low.
SP	A–3	100	100	0–5	>10. 0	. 04	7. 4–7. 8	Low.
CH	A–7	100	100	85–95	<0. 05	. 18	(3)	High.
SM	A–2	100	90–100	25–35	2. 5–5. 0	. 14	7. 4–7. 8	Low.
SM	A–4	100	95–100	35–50	2. 5–5. 0	. 14	7. 4–7. 8	Low.
SM or ML	A–4	100	95–100	35–65	2. 5–5. 0	. 14	7. 4–7. 8	Low.
SM or ML	A–2 or A–4	90–95	85–90	25–45	0. 8–5. 0	. 12	(3)	Low.
CL	A–6 or A–7	95–100	95–100	65–85	0. 2–0. 8	. 21	6. 1–6. 5	Moderate.
CH	A–7	100	100	85–95	<0. 05	. 17	6. 1–7. 8	High.
CH	A–7	100	100	95–100	<0. 05	. 16	(3)	High.
CL	A–6	100	100	85–95	0. 2–0. 8	. 16	7. 4–7. 8	Moderate.
CH	A–7	100	100	80–100	<0. 05	. 17	[3] 7. 4–7. 8	High.
ML	A–4	95–100	90–100	55–75	0. 8–2. 5	. 17	6. 1–6. 5	Low.
ML–CL	A–6	70–85	65–80	60–80	0. 2–2. 5	. 16	6. 1–7. 3	Low to moderate.
SP or SP–SM	A–1	55–80	50–70	0–10	>10. 0	. 03	(3)	Low.

TABLE 5.—*Estimated engineering*

Soil series and map symbols	Depth to seasonal high water table [1]	Depth from surface	Classification: USDA texture
	Ft.	*In.*	
Sisson: SfB, SfB2, SfC, SfC2	3+	0–12	Very fine sandy loam
		12–37	Stratified loam, silt loam, and fine sandy loam
		37–60	Stratified silt loam and very fine sand
Sloan: Sn	[2] <1	0–24	Loam
		24–34	Silt loam
		34–54	Stratified silt loam, loam, and fine sand
Spalding: So	0	0–48	Peat
For properties of Greenwood part of this mapping unit, see Greenwood series.			
Spinks: SpA, SpB, SpC, SpD, SpE, SpF	4+	0–9	Loamy sand
		9–19	Sand
		19–64	Stratified sand and loamy sand
		64–72	Sand
Tawas: Ta	0	0–32	Muck
		32–48	Sand
Tedrow: TeA, TeB	1–2	0–11	Loamy sand
		11–23	Loamy fine sand
		23–60	Fine sand
Tonkey: To	<1	0–37	Fine sandy loam, sandy loam
		37–42	Stratified loamy sand, sandy loam, and fine sandy loam
Tuscola: TuA, TuB	2–3	0–7	Very fine sandy loam
		7–36	Loam, silt loam
		36–42	Stratified silt, fine sand, and very fine sand
Ubly: UbA, UbB	2–3	0–18	Sandy loam
		18–26	Gravelly heavy loam
		26–34	Sand and gravel
		34–44	Clay loam
Warners: Wb	0	0–7	Muck
		7–42	Marl
Wasepi: WsA, WsB	1–2	0–11	Loamy sand
		11–32	Heavy sandy loam, light sandy loam
		32–48	Stratified sand and gravel
Willette: Wt	0	0–36	Muck and peat
		36–48	Light silty clay

[1] Assuming no artificial drainage. [2] Subject to flooding.

properties of the soils—Continued

Classification—Continued		Percentage passing sieve—			Permeability	Available water capacity	Reaction	Shrink-swell potential
Unified	AASHO	No. 4	No. 10	No. 200				
					In./hr.	*In./in.*	*pH*	
SM or ML	A–4	100	95–100	40–60	2. 5–5. 0	. 14	6. 1–7. 3	Low.
SM or ML	A–4 or A–6	100	95–100	35–75	0. 8–5. 0	. 18	6. 1–7. 8	Low.
SM or ML	A–4	100	95–100	35–70	0. 8–10. 0	. 18	(3)	Low.
ML	A–4	100	95–100	55–75	0. 8–2. 5	. 17	6. 6–7. 3	Low.
ML	A–4	100	95–100	65–90	0. 2–2. 5	. 18	7. 4–7. 8	Low.
SM or ML	A–4 or A–6	100	95–100	35–70	0. 8–10. 0	. 14	(3)	Low.
Pt					5. 0–10. 0	. 25	<5. 5	Variable.
SM	A–2	100	95–100	15–30	5. 0–10. 0	. 06	5. 6–6. 5	Low.
SP–SM or SP	A–3	100	95–100	0–10	5. 0–10. 0	. 03	6. 1–6. 5	Low.
SM or SP–SM	A–1 or A–2	100	95–100	10–30	5. 0–10. 0	. 08	6. 1–7. 3	Low.
SP or SP–SM	A–3	100	95–100	0–10	5. 0–10. 0	. 03	7. 4–7. 8	Low.
Pt					5. 0–10. 0	. 25	5. 6–6. 0	Variable.
SP or SP–SM	A–3	95–100	90–95	0–10	5. 0–10. 0	. 03	(3)	Low.
SM	A–2	100	95–100	15–30	5. 0–10. 0	. 05	5. 6–6. 0	Low.
SM	A–2	100	95–100	25–35	2. 5–5. 0	. 12	5. 6–7. 3	Low.
SP or SM	A–2 or A–3	100	95–100	0–20	5. 0–10. 0	. 03	[3] 7. 4–7. 8	Low.
SM or ML	A–4	100	95–100	35–50	2. 5–5. 0	. 14	6. 1–7. 8	Low.
SM or ML	A–2 or A–4	100	95–100	25–45	0. 8–2. 5	. 12	7. 4–7. 8	Low.
SM or ML	A–4	100	95–100	40–60	2. 5–5. 0	. 14	6. 1–6. 5	Low.
SM or ML	A–4 or A–6	100	95–100	55–75	0. 8–2. 5	. 18	6. 1–7. 3	Low.
SM or ML	A–4	100	95–100	35–70	0. 8–10. 0	. 18	(3)	Low.
SM	A–2	100	95–100	20–35	2. 5–5. 0	. 12	6. 1–7. 3	Low.
ML	A–4	70–85	65–80	60–75	0. 8–2. 5	. 16	6. 6–7. 3	Low.
SP	A–1 or A–3	65–85	60–80	0–5	>10. 0	. 02	(3)	Low.
CL	A–6 or A–7	90–100	85–95	60–80	0. 8–2. 5	. 16	(3)	Moderate.
Pt					5. 0–10. 0	. 25	7. 4–7. 8	Variable.
							(3)	Variable.
SM	A–2	95–100	90–100	15–25	2. 5–10. 0	. 06	6. 1–6. 5	Low.
SM	A–4	90–100	80–100	35–50	2. 5–5. 0	. 14	6. 1–7. 3	Low.
SP or SP–SM	A–1	55–80	50–70	0–10	>10. 0	. 03	(3)	Low.
Pt					5. 0–10. 0	. 50	5. 6–6. 5	Variable.
CH	A–7	100	100	80–100	<0. 05	. 17	[3] 6. 1–6. 5	High.

[3] Calcareous

TABLE 6.—*Engineering interpretations*

Soil series and map symbols	Suitability as source of—			
	Topsoil	Sand	Gravel	Road fill for highway subgrade
Abscota: Ab	Very poor: sandy texture; flood hazard.	Fair: stratified; considerable fines.	Not suitable	Fair to good: low shrink-swell potential; good compaction characteristics.
Adrian: Ad	Poor if used alone: erodible; readily oxidized. Fair to good if mixed with mineral material.	Fair: some fines; high water table.	Not suitable	Organic material, not suitable: unstable. Substratum, fair: sandy texture; wetness hinders excavation.
Alcona: AlA, AlB, AlC	Fair	Not suitable	Not suitable	Fair to good: low shrink-swell potential; good compaction characteristics; good workability.
Algansee: An	Very poor to poor: sandy texture; flood hazard; seasonal high water table.	Fair: stratified; considerable fines; seasonal high water table.	Not suitable	Fair to good: low shrink-swell potential; good compaction characteristics; slight frost action; wetness hinders excavation.
Allendale: AoA, AoB	Poor: sandy texture; droughtiness; seasonal high water table.	Not suitable to fair: limited source of sand with fines to a depth of 18 to 42 inches.	Not suitable	Subsoil, fair to good: low shrink-swell potential; fair to good bearing capacity. Substratum, not suitable to poor: high shrink-swell potential; wetness hinders excavation and makes soil material difficult to work and to compact.
Au Gres:				
AsB	Very poor: sandy texture; seasonal high water table.	Good: seasonal high water table.	Not suitable	Fair to good: low shrink-swell potential; fair compaction characteristics; wetness hinders excavation.
AuA	Very poor: sandy texture; droughtiness; seasonal high water table.	Not suitable to fair: limited source of sand with fines to a depth of 5 feet.	Not suitable	Subsoil, fair to good: low shrink-swell potential; fair to good bearing capacity. Substratum, poor to fair: moderate to high shrink-swell potential; wetness hinders excavation amd makes soil material difficult to work.
Barry: Ba	Good: high water table.	Not suitable	Not suitable	Fair to good: fair workability; fair compaction characteristics; some stones; low to moderate shrink-swell potential; wetness hinders excavation.
Belding: BeA, BeB	Fair: seasonal high water table.	Not suitable	Not suitable	Fair to good: low to moderate shrink-swell potential; medium compressibility; fair workability; wetness hinders excavation in some areas.
Belding, clay subsoil variant: BfA, BfB.	Fair: seasonal high water table.	Not suitable	Not suitable	Subsoil, fair to good: low shrink-swell potential; low compressibility. Substratum, poor: high shrink-swell potential; high compressibility; hazard of frost action; wetness hinders excavation.

for specified uses

Suitability as source of—con.	Soil properties affecting—		Corrosion potential	
Impermeable material	Highway location	Winter grading	Untreated steel	Concrete
Not suitable: sandy texture; pervious.	Flood hazard	Moisture content at times too high for good compaction.	Moderate	Low.
Not suitable: unstable	High water table; unstable organic material, which must be removed; sandy substratum.	High water table; unstable organic material.	High	Low.
Fair: semipervious	Fair to good bearing capacity; good workability.	Moisture content often high enough to make compaction difficult; poor stability upon thawing.	Low	Low.
Not suitable: sandy texture; pervious.	Flood hazard; seasonal high water table.	Moisture content at times high enough to hinder operations.	Moderate	Low.
Subsoil, not suitable. Substratum, good: seasonal high water table; difficult to compact.	Seasonal high water table; plastic, clayey material at a depth of 18 to 42 inches; unstable and slippery when wet; poor to fair bearing capacity.	Moisture content often high enough to hinder operations; poor stability upon thawing.	High	Low.
Not suitable: sandy texture; pervious.	Seasonal high water table; sandy texture.	Wetness often hinders operations.	Low	Moderate.
Subsoil, not suitable: sandy texture; pervious. Substratum, good.	Seasonal high water table; wetness hinders construction at times; substratum subject to frost heave.	Wetness often hinders operations.	Moderate in sandy layers; high in substratum.	Low to moderate.
Fair to good: semipervious to impervious; stones and gravel in some areas; high water table.	High water table; wetness hinders construction.	High water table; wetness hinders operations.	High	Low.
Good: impervious; difficult to work and compact when wet; seasonal high water table.	Seasonal high water table; wetness hinders construction in some areas.	Moisture content often too high for good compaction; poor stability upon thawing.	High	Low.
Subsoil, not suitable: pervious. Substratum, good: impervious; difficult to work and compact when wet; seasonal high water table.	Seasonal high water table; plastic clay at a depth of 18 to 42 inches; unstable and slippery when wet; poor to fair bearing capacity.	High moisture content often hinders operations; clayey substratum has poor stability upon thawing.	High	Low.

TABLE 6.—*Engineering interpretations*

Soil series and map symbols	Suitability as source of—			
	Topsoil	Sand	Gravel	Road fill for highway subgrade
Berville: Bh	Good: high water table.	Not suitable	Not suitable	Subsoil and substratum, poor to fair: medium shear strength; fair workability; low to moderate shrink-swell potential; wetness hinders excavation.
Blount: BlA, BlB, BlB2	Fair: thin; crusts slightly when dry; seasonal high water table.	Not suitable	Not suitable	Poor to fair: moderate shrink-swell potential; difficult to work and compact when wet; hazard of frost heave; wetness hinders excavation in some areas.
Borrow pits: Bp. Variable; onsite investigation needed.				
Boyer: BrA, BrB, BrC, BrD, BrE, BrF, BsA, BsB, BsC, BsD.	Poor: droughtiness; low organic-matter content.	Good: poorly graded sand, gravel, and some fines.	Fair to good: poorly graded sand and gravel.	Good: low shrink-swell potential; good workability; good source of subbase material.
Brady: BtA, BtB	Poor: surface stones in some areas; seasonal high water table.	Good: poorly graded sand, gravel, and some fines; seasonal high water table.	Fair to good: poorly graded sand and gravel; seasonal high water table.	Good: low shrink-swell potential; good workability; low compressibility; wetness hinders excavation in some areas.
Breckenridge: Bu	Good: medium to high organic-matter content; high water table.	Not suitable	Not suitable	Subsoil, fair: low shrink-swell potential; poor to fair bearing capacity. Substratum, poor: moderate shrink-swell potential; difficult to work and compact when wet; wetness hinders excavation.
Brevort: Bv	Poor: sandy texture; medium organic-matter content; high water table.	Fair: limited source of sand with some fines to a depth of 1 to 3 feet.	Not suitable	Subsoil, fair to good: low shrink-swell potential; fair to good bearing capacity. Substratum, poor to fair: moderate shrink-swell potential; difficult to work and compact when wet; wetness hinders excavation.
Brookston: Bw	Good: loamy texture; medium to high organic-matter content; high water table.	Not suitable	Not suitable	Poor to fair: moderate shrink-swell potential; difficult to work and compact when wet; hazard of frost heave; wetness hinders excavation.
Capac: CaA, CaB	Good: seasonal high water table.	Not suitable	Not suitable	Fair: moderate shrink-swell potential; poor to fair bearing capacity; wetness hinders excavation in some areas.
Carlisle: Cc	Poor if used alone: erodible; readily oxidized; high water table. Fair to good if mixed with mineral soil.	Not suitable	Not suitable	Not suitable: unstable
Celina: CeA, CeB, CeB2	Good: loamy texture; thin where eroded.	Not suitable	Not suitable	Poor to fair: low to moderate shrink-swell potential; difficult to work and compact when wet; hazard of frost heave.

for specified uses—Continued

Suitability as source of—con.	Soil properties affecting—		Corrosion potential	
Impermeable material	Highway location	Winter grading	Untreated steel	Concrete
Subsoil and substratum, good: high water table.	High water table; wetness hinders construction; poor to fair bearing capacity; hazard of frost heave.	High water table; poor stability upon thawing.	High	Low.
Good: impervious; difficult to work and compact when wet; seasonal high water table.	Seasonal high water table; wetness hinders construction in some areas; hazard of frost heave.	Moisture content often too high for good compaction; poor stability upon thawing.	High	Low.
Subsoil, fair to good. Substratum, not suitable: very pervious sand and gravel; piping hazard.	Cuts and fills needed in many places; substratum a good source of fill and subbase material.	Low to medium moisture content; fair stability upon thawing.	Low to moderate.	Low.
Not suitable: pervious; seasonal high water table.	Seasonal high water table; wetness hinders construction in some places; substratum a good source of fill and subbase material.	Wetness often hinders operations; poor stability upon thawing.	Moderate	Low to moderate.
Subsoil, fair: thin. Substratum, good: high water table.	High water table; wetness hinders construction; poor to fair bearing capacity.	High water table; poor stability upon thawing.	High	Low.
Subsoil, not suitable; pervious. Substratum, good: impervious.	High water table; wetness hinders construction; poor to fair bearing capacity.	High water table; poor stability upon thawing.	High	Low.
Good: impervious; difficult to work when wet; high water table.	High water table; wetness hinders construction; hazard of frost heave; moderate shrink-swell potential.	High water table; poor stability upon thawing.	High	Low.
Good: semipervious to impervious; seasonal high water table.	Seasonal high water table; wetness hinders construction in some areas; poor to fair bearing capacity.	Moisture content often too high for good compaction; poor stability upon thawing.	High	Low.
Not suitable: unstable	High water table; unstable organic material, which must be removed.	High water table; unstable organic material.	High	Moderate.
Good: semipervious to impervious.	Poor to fair bearing capacity; hazard of frost heave.	Moisture content often too high for good compaction; poor stability upon thawing.	Moderate	Low.

TABLE 6.—*Engineering interpretations*

Soil series and map symbols	Suitability as source of—			
	Topsoil	Sand	Gravel	Road fill for highway subgrade
Ceresco: Cf	Fair: flood hazard; seasonal high water table.	Not suitable	Not suitable	Fair to good: low shrink-swell potential; fair workability; hazard of frost heave; wetness hinders excavation.
Chelsea: ChB, ChC, ChD	Very poor: sandy texture; droughtiness.	Good: some narrow bands of fines.	Not suitable	Fair to good: low shrink-swell potential; low compressibility; good workability.
Cohoctah: Cm	Fair: flood hazard; high water table.	Not suitable	Not suitable	Fair to good: low shrink-swell potential; fair workability; hazard of frost heave; wetness hinders excavation.
Colwood: Co	Good: loamy texture; medium to high organic-matter content; high water table.	Not suitable	Not suitable	Poor to fair: low shrink-swell potential; poor bearing capacity; hazard of frost heave; wetness hinders excavation.
Conover: CvA, CvB	Good: loamy texture; seasonal high water table.	Not suitable	Not suitable	Poor to fair: low to moderate shrink-swell potential; difficult to work and compact when wet; wetness hinders excavation in some areas.
Del Rey: DrA, DrB	Good: seasonal high water table.	Not suitable	Not suitable	Poor to fair: moderate shrink-swell potential; difficult to work and compact when wet; hazard of frost heave; wetness hinders excavation.
Dryden: DyA, DyB	Fair to good: stony in some areas.	Not suitable	Not suitable	Fair to good: low to moderate shrink-swell potential; good workability; good compaction characteristics.
Edwards: Ed	Poor if used alone: crodible; readily oxidized; high water table. Fair to good if mixed with mineral soil.	Not suitable	Not suitable	Not suitable: unstable
Fabius: FaA, FaB For Wasepi part of these mapping units, see Wasepi series.	Fair: stony in some areas; seasonal high water table.	Good: poorly graded sand with some fines and gravel; seasonal high water table.	Fair: poorly graded sand and gravel (less than 50 percent gravel); seasonal high water table.	Subsoil, fair: low to moderate shrink-swell potential; good compaction characteristics; good workability. Substratum, fair to good: low shrink-swell potential; low compressibility; wetness hinders excavation.
Fox: FoA, FoB, FoC2	Fair: thin where eroded.	Good: poorly graded sand, gravel, and some fines.	Good: poorly graded sand, gravel, and some fines.	Subsoil, fair: low to moderate shrink-swell potential; fair compaction characteristics; fair workability. Substratum, good: low shrink-swell potential; low compressibility.
Gilford: Gd	Good: medium to high organic-matter content; high water table.	Good: poorly graded sand, gravel, and some fines; high water table.	Fair to good: poorly graded sand, gravel, and some fines; high water table.	Subsoil, fair: low shrink-swell potential; good workability; good compaction characteristics. Substratum, good: low shrink-swell potential; low compressibility; wetness hinders excavation.

for specified uses—Continued

Suitability as source of—con.	Soil properties affecting—		Corrosion potential	
Impermeable material	Highway location	Winter grading	Untreated steel	Concrete
Fair: semipervious; flood hazard; seasonal high water table.	Seasonal high water table; flood hazard; poor to fair bearing capacity.	Moisture content at times high enough to hinder operations.	Moderate	Low.
Not suitable: pervious	Cuts and fills needed in many places; loose sand easy to excavate but sometimes has poor trafficability.	Sandy texture; low moisture content; good drainage.	Low	Low.
Fair: semipervious; flood hazard; high water table.	High water table; flood hazard; fair to good bearing capacity.	High water table; wetness hinders operations; poor stability upon thawing.	Moderate	Low.
Fair: semipervious; stratified material; difficult to work when wet; high water table.	High water table; substratum flows when wet; hazard of frost heave.	High water table; poor stability upon thawing.	High	Low.
Good: impervious; difficult to work when wet; seasonal high water table.	Seasonal high water table; wetness hinders construction in some areas; poor to fair bearing capacity; hazard of frost heave.	Moisture content often too high for good compaction; poor stability upon thawing.	High	Low.
Good: impervious; difficult to work and compact when wet; seasonal high water table.	Seasonal high water table; hazard of frost heave; difficult to work and compact when wet.	Moisture content often too high for good compaction; poor stability upon thawing.	High	Low.
Fair: semipervious; sandy pockets in some areas; good workability; good compaction characteristics.	Fair to good bearing capacity; stones hinder grading in some areas.	Moisture content often high enough to make compaction difficult; poor stability upon thawing.	Moderate	Low.
Not suitable: unstable	High water table; unstable organic material and marl, both of which must be removed.	High water table; unstable organic material.	High	Low.
Not suitable: pervious	Seasonal high water table; wetness hinders construction at times; good bearing capacity in substratum.	Moisture content at times high enough to hinder operations.	Moderate	Low.
Subsoil, good: fair workability; fair compaction characteristics. Substratum, not suitable: pervious.	Good bearing capacity in substratum; substratum a good source of fill and subbase material.	Moisture content usually too high for good compaction; poor stability upon thawing.	Low to moderate.	Low.
Not suitable: pervious; high water table.	High water table; wetness hinders construction.	High water table; wetness often hinders operations.	High	Low.

TABLE 6.—*Engineering interpretations*

Soil series and map symbols	Suitability as source of—			
	Topsoil	Sand	Gravel	Road fill for highway subgrade
Glendora: Ge	Fair to good: flood hazard; high water table.	Poor to fair: some fines; high water table.	Not suitable	Fair to good: low shrink-swell potential; low compressibility; fair workability; wetness hinders excavation.
Granby: Gm, Gn	Poor to fair: high water table.	Good: high water table.	Not suitable	Fair to good: low shrink-swell potential; low compressibility; fair workability; good compaction characteristics; wetness hinders excavation.
Gravel pits: Gr. Variable; onsite investigation needed.				
Greenwood. Mapped only with Spalding soils.	Poor if used alone: very acid; erodible; readily oxidized. Fair to good if mixed with mineral soil.	Not suitable	Not suitable	Not suitable: unstable
Gullied land: Gs, Gu. Variable; onsite investigation needed.				
Houghton: Ho	Poor if used alone: erodible; readily oxidized; high water table. Fair to good if mixed with mineral soil.	Not suitable	Not suitable	Not suitable: unstable
Hoytville: Ht, Hy	Fair for silt loam (Ht), poor for silty clay loam (Hy): sticky when wet; high water table.	Not suitable	Not suitable	Poor: high shrink-swell potential; high compressibility; poor compaction characteristics; poor workability when wet; wetness hinders excavation.
Iosco: IoA	Very poor: sandy texture; droughtiness; low organic-matter content; seasonal high water table.	Not suitable to fair: limited source of sand with fines to a depth of 3½ feet.	Not suitable	Subsoil, fair to good: sandy texture; low shrink-swell potential; fair to good bearing capacity. Substratum, poor to fair: clayey texture; low to moderate shrink-swell potential; difficult to work when wet; wetness hinders excavation at times.
Kibbie: KbA, KbB	Good: loamy texture; seasonal high water table.	Not suitable	Not suitable	Poor: low to moderate shrink-swell potential; hazard of frost heave; substratum flows when wet; wetness hinders excavation at times.
Lapeer: LaA, LaB, LaB2, LaC, LaC2, LaC3, LaD2, LaD3, LaE2, LaE3, LaF.	Fair	Not suitable	Not suitable	Fair to good: low shrink-swell potential; stones and cobblestones.
Lenawee: Le	Poor to fair: sticky when wet; high water table.	Not suitable	Not suitable	Poor to fair: moderate shrink-swell potential; hazard of frost heave; difficult to work and compact when wet; wetness hinders excavation.
Linwood: Lm	Poor if used alone: erodible; readily oxidized; high water table. Fair to good if mixed with mineral soil.	Not suitable	Not suitable	Organic layer, not suitable: unstable. Substratum, poor: low shrink-swell potential; hazard of frost heave; wetness hinders excavation.

for specified uses—Continued

Suitability as source of—con.	Soil properties affecting—		Corrosion potential	
Impermeable material	Highway location	Winter grading	Untreated steel	Concrete
Not suitable: pervious; high water table.	High water table; flood hazard; good bearing capacity.	High water table; wetness hinders operations.	Moderate	Low.
Not suitable: pervious; high water table.	High water table; sandy soil flows when wet.	High water table; wetness hinders operations.	Moderate	Low.
Not suitable: unstable	High water table; unstable organic material, which must be removed.	High water table; unstable organic material.	High	High.
Not suitable: unstable	High water table; unstable organic material, which must be removed.	High water table; unstable organic material.	High	Moderate.
Good: impervious; difficult to work and compact when wet; high water table.	High water table; poor to fair bearing capacity; low shear strength; unstable and slippery when wet.	High water table; clayey subsoil; poor stability upon thawing.	High	Low.
Subsoil, not suitable: sandy texture. Substratum, good: clayey texture; impervious; seasonal high water table.	Seasonal high water table; wetness hinders construction at times; hazard of frost heave in substratum.	Moisture content often too high for good compaction; poor stability upon thawing.	High	Low.
Fair: semipervious; substratum liquefies readily and flows when wet; seasonal high water table.	Seasonal high water table; substratum flows when wet; hazard of frost heave.	Moisture content often too high for good compaction; poor stability upon thawing.	Moderate	Low.
Fair: good workability; good compaction characteristics.	Cuts and fills needed in many places; stones hinder grading in some areas; fair to good bearing capacity.	Moisture content often too high for good compaction; poor stability upon thawing.	Low to moderate.	Low.
Good: impervious; difficult to work and compact when wet; high water table	High water table; wetness hinders construction; poor to fair bearing capacity.	High water table; poor stability upon thawing.	High	Low.
Organic layer, not suitable; unstable. Substratum, fair: impervious; difficult to work and compact when wet; high water table.	High water table; unstable organic material, which must be removed; poor bearing capacity in substratum.	High water table; unstable organic material.	High	Low.

TABLE 6.—*Engineering interpretations*

Soil series and map symbols	Suitability as source of—			
	Topsoil	Sand	Gravel	Road fill for highway subgrade
Locke: LoA, LoB	Fair to good: seasonal high water table.	Not suitable	Not suitable	Subsoil, fair: low to moderate shrink-swell potential; good workability; good compaction characteristics. Substratum, fair to good: low shrink-swell potential; low compressibility; wetness hinders excavation in some areas.
Lupton: Lu	Poor if used alone: erodible; readily oxidized; high water table. Fair to good if mixed with mineral soil.	Not suitable	Not suitable	Not suitable: unstable
Macomb: MaA, MaB	Fair: stony in some areas; seasonal high water table.	Not suitable	Not suitable	Fair to good: low shrink-swell potential; good compaction characteristics; wetness hinders excavation in some areas.
Made land: Md. Variable; onsite investigation needed.				
Mancelona: MeB, MeC2	Poor: sandy texture; droughtiness.	Not suitable	Not suitable	Subsoil, fair to good: sandy texture; low shrink-swell potential; fair to good bearing capacity. Substratum, poor: clayey texture; moderate shrink-swell potential; difficult to work and compact when wet.
Marlette: MfA, MfB, MfB2, MfC, MfC2, MfC3, MfD2, MfD3, MfE2, MfF2.	Fair to good: loamy texture; thin where eroded.	Not suitable	Not suitable	Poor to fair: moderate to high shrink-swell potential; poor to fair bearing capacity; difficult to work and compact when wet.
Matherton: MhA, MhB	Good: loamy texture; seasonal high water table.	Good: poorly graded sand and gravel with some fines; seasonal high water table.	Good: poorly graded sand and gravel with some fines; seasonal high water table.	Subsoil, fair: low to moderate shrink-swell potential; good workability; good compaction characteristics. Substratum, good: low shrink-well potential; good workability; fair compaction characteristics; wetness hinders excavation in some areas.
McBride: MkB, MkB2, MkC2, MlA, MlB, MlB2, MlC, MlC2, MlC3, MlD, MlD2, MlD3, MlE2, MlF.	Fair: sandy texture; thin where eroded.	Not suitable	Not suitable	Fair to good: low shrink-swell potential; fair to good bearing capacity.
Menominee: MmA, MmB, MmC, MmD.	Poor: sandy texture; droughtiness; low organic-matter content.	Not suitable to fair: limited source of sand with fines to a depth of 42 inches.	Not suitable	Upper part, fair: sandy texture; low shrink-swell potential; fair workability. Substratum, fair: loamy texture; low to moderate shrink-swell potential; fair workability when wet.
Metamora: MnA, MnB	Fair: seasonal high water table.	Not suitable	Not suitable	Fair to good: low to moderate shrink-swell potential; fair workability; wetness hinders excavation in some areas.

for specified uses—Continued

Suitability as source of—con.	Soil properties affecting—		Corrosion potential	
Impermeable material	Highway location	Winter grading	Untreated steel	Concrete
Fair: semipervious; sandy pockets in some areas; seasonal high water table.	Seasonal high water table; wetness hinders construction in some areas; fair to good bearing capacity.	Moisture content often too high for good compaction; poor stability upon thawing.	Moderate	Low.
Not suitable: unstable	High water table; unstable organic material, which must be removed.	High water table; unstable organic material.	High	Low.
Good: semipervious to impervious; low shrink-swell potential; good compaction characteristics; seasonal high water table.	Seasonal high water table; wetness hinders construction in some areas; fair to poor bearing capacity.	Moisture content often too high for good compaction; poor stability upon thawing.	High	Low.
Subsoil, fair: sandy texture. Substratum, good: clayey texture.	Poor to fair bearing capacity in substratum; hazard of frost heave in substratum.	Medium to high moisture content; poor stability upon thawing.	Moderate	Low.
Good: difficult to work and compact when wet.	Cuts and fills needed in many places; poor to fair bearing capacity.	Moisture content often too high for good compaction; poor stability upon thawing.	Moderate	Low.
Subsoil, good: good workability; fair compaction characteristics. Substratum, not suitable: pervious.	Seasonal high water table; wetness hinders construction in some areas; good bearing capacity in substratum.	Moisture content at times high enough to hinder operations.	Moderate	Low.
Fair to good: good workability; good compaction characteristics.	Cuts and fills needed in many places; fair to good bearing capacity.	Moisture content often high enough to make compaction difficult; poor stability upon thawing.	Moderate	Low.
Upper part, not suitable: sandy texture; pervious. Substratum, good: loamy texture; impervious.	Cuts and fills needed in many places; fair bearing capacity in substratum.	Moisture content often too high for good compaction; poor stability upon thawing.	Moderate	Low.
Subsoil, fair to good: semipervious to impervious. Substratum, good: impervious; seasonal high water table.	Seasonal high water table; wetness hinders construction in some areas; poor to fair bearing capacity.	Moisture content often too high for good compaction; poor stability upon thawing.	High	Low.

TABLE 6.—*Engineering interpretations*

Soil series and map symbols	Suitability as source of—			
	Topsoil	Sand	Gravel	Road fill for highway subgrade
Miami: MoB, MoB2, MoC, MoC2, MoD, MoD2, MoE, MoE2, MoF, MoF2, MpC3, MpD3, MpE3, MpF3.	Fair to good: loamy texture; thin and sticky where eroded.	Not suitable	Not suitable	Poor to fair: low to moderate shrink-swell potential; difficult to work and compact when wet.
Montcalm: MrA, MrB, MrC, MrD, MrE, MrF, MsA, MsB.	Poor: sandy texture; droughtiness; hazard of soil blowing.	Fair: some layers contain fines.	Not suitable	Fair to good: low shrink-swell potential; fair to good bearing capacity; loose, sandy material easy to excavate but sometimes hinders hauling.
Morley: MtB, MtB2, MtC, MtC2, MtD2, MuC3, MuD3, MuE3.	Fair to good: thin and sticky where eroded.	Not suitable	Not suitable	Poor to fair: moderate to high shrink-swell potential; difficult to work and compact when wet.
Munuscong: Mv	Fair: medium to high organic-matter content; high water table.	Not suitable	Not suitable	Subsoil, fair to good: low shrink-swell potential; fair bearing capacity. Substratum, poor: high shrink-swell potential; poor to fair bearing capacity; difficult to work and compact when wet; wetness hinders excavation.
Mussey: Mw For Gilford part of this mapping unit, see Gilford series.	Good: high water table.	Good: poorly graded sand, gravel, and some fines; high water table.	Good: poorly graded sand, gravel, and some fines; high water table.	Subsoil, fair: good workability; thin. Substratum, fair to good: low shrink-swell potential; low compressibility; wetness hinders excavation.
Nappanee: NaA, NaB, NpA, NpB2.	Loam (NaA, NaB), fair; silty clay loam (NpA, NpB2), poor: seasonal high water table; some areas sticky when wet.	Not suitable	Not suitable	Poor: high shrink-swell potential; high compressibility; difficult to work and compact when wet; wetness hinders excavation in some areas.
Oshtemo: OsA, OsB, OsC	Poor: sandy texture; droughtiness; low organic-matter content.	Good: poorly graded sand; some gravel and fines.	Fair: dominantly sand, but 20 to 45 percent gravel.	Subsoil, fair: low shrink-swell potential; good workability; good compaction characteristics. Substratum, good: low shrink-swell potential; fair workability; fair compaction characteristics.
Owosso: OwA, OwB, OwC, OwC2.	Fair: low to medium organic-matter content.	Not suitable	Not suitable	Subsoil, fair: sandy texture; low shrink-swell potential; fair to good bearing capacity. Substratum, poor to fair: loamy texture; low to moderate shrink-swell potential; difficult to work and compact when wet; poor to fair bearing capacity.
Paulding: Pa	Poor: clayey texture; sticky when wet; high water table.	Not suitable	Not suitable	Poor: high shrink-swell potential; high compressibility; difficult to work and compact when wet; wetness hinders excavation.

for specified uses—Continued

Suitability as source of—con.	Soil properties affecting—		Corrosion potential	
Impermeable material	Highway location	Winter grading	Untreated steel	Concrete
Good: impervious; fair compaction characteristics.	Cuts and fills needed in many places; poor to fair bearing capacity.	Moisture content often too high for good compaction; poor stability upon thawing.	Moderate	Low.
Not suitable: sandy texture; rapid permeability; hazard of piping.	Cuts and fills needed in many places; loose, sandy material easy to excavate but sometimes has poor trafficability.	Sandy texture; low moisture content; good drainage.	Low	Low.
Good: impervious; difficult to work and compact when wet.	Cuts and fills needed in many places; poor to fair bearing capacity; hazard of frost heave.	Moisture content often too high for good compaction; poor stability upon thawing.	Moderate	Low.
Subsoil, fair: semipervious; thin. Substratum, good: impervious; difficult to work and compact when wet; high water table.	High water table; poor to fair bearing capacity; plastic, clayey material at a depth of 18 to 42 inches; unstable and slippery when wet.	High water table; clayey texture; poor stability upon thawing.	High	Low.
Subsoil, not suitable: thin. Substratum, not suitable: pervious; piping hazard; high water table.	High water table; wetness hinders construction.	High water table; wetness often hinders operations.	High	Low.
Good: impervious; difficult to work and compact when wet; seasonal high water table.	Seasonal high water table; poor to fair bearing capacity; plastic, clayey material that is unstable and slippery when wet.	Moisture content at times high enough to hinder operations; poor stability upon thawing.	High	Low.
Not suitable: pervious	Good bearing capacity in substratum; substratum good source of subbase and fill material.	Moisture content usually low to medium; fair stability upon thawing.	Low	Low.
Subsoil, fair: thin. Substratum, good.	Cuts and fills needed in many places; poor to fair bearing capacity in substratum.	Moisture content medium to high; poor stability upon thawing.	Low	Low.
Good: impervious; difficult to work and compact when wet; high water table.	High water table; poor to fair bearing capacity; plastic, clayey material that is unstable and slippery when wet.	High water table; clayey texture; poor stability upon thawing.	High	Low.

TABLE 6.—*Engineering interpretations*

Soil series and map symbols	Suitability as source of—			
	Topsoil	Sand	Gravel	Road fill for highway subgrade
Pewamo: Pe, Pm	Loam (Pe), fair; clay loam (Pm), poor: high water table; some areas sticky when wet.	Not suitable	Not suitable	Poor to fair: moderate to high shrink-swell potential; difficult to work and compact when wet; wetness hinders excavation.
Pinconning: Pn	Poor: sandy texture; high water table.	Not suitable to fair: limited source of sand with fines to a depth of 3½ feet.	Not suitable	Subsoil, fair to good: low shrink-swell potential; fair to good bearing capacity. Substratum, poor: high shrink-swell potential; poor to fair bearing capacity; difficult to work and compact when wet; wetness hinders excavation.
Richter: RcA, RcB	Fair: low organic-matter content; seasonal high water table.	Not suitable	Not suitable	Fair: low shrink-swell potential; fair bearing capacity; hazard of frost heave; wetness hinders excavation in some areas.
Roselms: RoA, RoB, RoB2	Poor: clayey texture; sticky when wet; seasonal high water table.	Not suitable	Not suitable	Poor: high shrink-swell potential; high compressibility; difficult to work and compact when wet; wetness hinders excavation in some areas.
St. Clair: ScB2, ScC2	Poor: clayey texture; thin and sticky where eroded.	Not suitable	Not suitable	Poor: high shrink-swell potential; high compressibility; difficult to work and compact when wet.
Sebewa: Se	Good: stony in some areas; high water table.	Good: poorly graded sand, gravel, and some fines; high water table.	Good: poorly graded sand, gravel, and some fines; high water table.	Subsoil, poor to fair: low to moderate shrink-swell potential. Substratum, fair to good: low shrink-swell potential; low compressibility; wetness hinders excavation.
Sisson: SfB, SfB2, SfC, SfC2	Good: loamy texture.	Not suitable to poor: highly variable; stratified sand and fines.	Not suitable	Poor: low shrink-swell potential; hazard of frost heave; may be difficult to work and compact when wet; may flow when wet.
Sloan: Sn	Good: loamy texture; flood hazard; high water table.	Not suitable	Not suitable	Poor: low shrink-swell potential; hazard of frost heave; flood hazard; wetness hinders excavation.
Spalding: So For Greenwood part of this mapping unit, see Greenwood series.	Poor if used alone: erodible; readily oxidized; high water table. Fair if mixed with mineral soil.	Not suitable	Not suitable	Not suitable: unstable
Spinks: SpA, SpB, SpC, SpD, SpE, SpF.	Poor: sandy texture; droughtiness; low organic-matter content.	Good below a depth of 5½ feet; some fines above that depth.	Not suitable	Fair to good: low shrink-swell potential; low compressibility; fair to good workability; fair to good compaction characteristics.

for specified uses—Continued

Suitability as source of—Con.	Soil properties affecting—		Corrosion potential	
Impermeable material	Highway location	Winter grading	Untreated steel	Concrete
Good: impervious; difficult to work and compact when wet; high water table.	High water table; wetness hinders construction; poor to fair bearing capacity; hazard of frost heave.	High water table; poor stability upon thawing.	High	Low.
Subsoil, not suitable: sandy texture; pervious. Substratum, good: clayey texture; impervious; difficult to work and compact when wet; high water table.	High water table; poor to fair bearing capacity; plastic, clayey material that is unstable and slippery when wet at a depth of 18 to 42 inches.	High water table; clayey texture; poor stability on thawing.	High	Low.
Fair: good workability; good compaction characteristics; substratum loses stability and flows when wet.	Seasonal high water table; substratum loses stability and flows when wet; hazard of frost heave.	Moisture content often too high for good compaction; poor stability upon thawing.	Moderate	Low.
Good: impervious; seasonal high water table; difficult to work and compact when wet.	Seasonal high water table; low shear strength; poor to fair bearing capacity; plastic, clayey material that is unstable and slippery when wet.	High water table; clayey texture; poor stability upon thawing.	High	Low.
Good: impervious	Poor to fair bearing capacity; hazard of frost heave; plastic, clayey material that is soft and slippery when wet.	Moisture content often too high for good compaction; poor stability upon thawing.	High	Low.
Subsoil, good: fair workability; fair compaction characteristics. Substratum, not suitable: sandy texture; pervious.	High water table; wetness hinders construction.	High water table; wetness often hinders operations.	High	Low.
Fair: semipervious; stratified	Unstable substratum; hazard of frost heave.	Moisture content often too high for good compaction; poor stability upon thawing.	Low	Low.
Fair to good: semipervious to impervious; stratified; flood hazard; high water table.	High water table; flood hazard; poor to fair bearing capacity; hazard of frost heave.	High water table; wetness hinders operations; poor stability upon thawing.	High	Low.
Not suitable: unstable	High water table; unstable organic material, which must be removed.	High water table; unstable organic material.	High	High.
Not suitable: pervious	Cuts and fills needed in many places; loose sand easy to excavate but sometimes has poor trafficability; good bearing capacity; hazard of soil blowing.	Sandy texture; moisture content usually low; good stability upon thawing.	Low	Low.

TABLE 6.—*Engineering interpretations*

Soil series and map symbols	Suitability as source of—			
	Topsoil	Sand	Gravel	Road fill for highway subgrade
Tawas: Ta	Poor if used alone: erodible; readily oxidized; high water table. Fair to good if mixed with mineral soil.	Fair below a depth of 1½ to 3 feet.	Not suitable	Organic layer, not suitable: unstable. Substratum, poor: sandy texture; piping hazard; wetness hinders excavation.
Tedrow: TeA, TeB	Poor: sandy texture; low organic-matter content; seasonal high water table.	Good below a depth of 2 or 3 feet; seasonal high water table.	Not suitable	Fair to good: low shrink-swell potential; low compressibility; fair to good workability; fair to good compaction characteristics; wetness hinders excavation in some areas.
Tonkey: To	Good: medium to high organic-matter content; high water table.	Not suitable	Not suitable	Poor: low shrink-swell potential; poor to fair bearing capacity; hazard of frost heave; wetness hinders excavation.
Tuscola: TuA, TuB	Good: loamy texture.	Not suitable to poor: highly variable; stratified sand and fines.	Not suitable	Poor to fair: low shrink-swell potential; hazard of frost heave; may be difficult to work and compact when wet; may flow when wet.
Ubly: UbA, UbB	Fair: low organic-matter content.	Not suitable	Not suitable	Subsoil, fair: low shrink-swell potential; fair bearing capacity. Substratum, poor to fair: moderate shrink-swell potential; poor bearing capacity; difficult to work and compact when wet.
Warners: Wb	Poor: thin layer of muck over marl.	Not suitable	Not suitable	Not suitable: unstable
Wasepi: WsA, WsB	Poor: sandy texture; droughtiness; seasonal high water table.	Good: poorly graded sand, gravel, and some fines; seasonal high water table.	Good: poorly graded sand, gravel, and some fines; seasonal high water table.	Subsoil, fair: low shrink-swell potential; good workability; good compaction characteristics; wetness hinders excavation in some areas.
Willette: Wt	Poor if used alone: erodible; readily oxidized; high water table. Fair if mixed with mineral soil.	Not suitable	Not suitable	Organic layer, not suitable: unstable. Substratum, poor: difficult to work and compact when wet; wetness hinders excavation.

for specified uses—Continued

Suitability as source of—Con.	Soil properties affecting—		Corrosion potentia	
Impermeable material	Highway location	Winter grading	Untreated steel	Concrete
Organic layer, not suitable: unstable. Substratum, not suitable: pervious; high water table.	High water table; unstable organic material, which must be removed; sandy substratum.	High water table; unstable organic material.	High	Low.
Not suitable: pervious	Seasonal high water table; sandy texture; loses stability and flows when wet.	Wetness often hinders operations.	Moderate	Low.
Fair: liquifies readily and flows when wet; high water table.	High water table; wetness hinders excavation; poor to fair bearing capacity.	High water table; poor stability upon thawing.	High	Low.
Fair: semipervious; stratified	Unstable substratum; hazard of frost heave.	Moisture content often too high for good compaction; poor stability upon thawing.	Moderate	Low.
Subsoil, good. Substratum, fair to good.	Poor to fair bearing capacity	Moisture content often too high for good compaction; poor stability upon thawing.	Low	Low.
Not suitable: unstable	High water table; thin layer of unstable organic material over marl, both of which must be removed.	High water table; unstable organic material and marl.	High	Low.
Not suitable: pervious; seasonal high water table.	Seasonal high water table; wetness hinders construction at times; good bearing capacity in substratum.	Moisture content at times high enough to hinder operations.	Moderate	Low.
Organic layer, not suitable: unstable. Substratum, good: impervious; high water table; difficult to work and compact when wet.	High water table; unstable organic material that must be removed.	High water table; unstable organic material.	High	Low.

TABLE 7.—*Engineering interpretations for*

Soil series and map symbols	Soil properties affecting—			
	Agricultural drainage	Irrigation	Terraces and diversions	Grassed waterways
Abscota: Ab	Not needed	Low available water capacity; very rapid water intake; flood hazard.	Not needed: nearly level.	Not needed: nearly level.
Adrian: Ad	High water table; sandy substratum; ditchbanks unstable.	High available water capacity; very rapid water intake; very poor natural drainage.	Unstable organic material and sand likely to blow and fill channels. Terraces not needed: level or depressional.	Not needed: level or depressional.
Alcona: AlA, AlB, AlC	Not needed	Medium available water capacity; rapid water intake.	Shallow to erodible sand; difficult to vegetate.	Moderately coarse texture; difficult to vegetate; little runoff.
Algansee: An	Normally not suitable for crops.	Low available water capacity; very rapid water intake; flood hazard.	Not needed: nearly level.	Not needed: nearly level.
Allendale: AoA, AoB	Slow permeability at a depth of 18 to 42 inches; seasonal high water table.	Moderately low available water capacity; very rapid water intake; slow permeability at a depth of 18 to 42 inches.	Not needed: sandy texture; nearly level to gently sloping; little runoff.	Not needed: sandy texture; nearly level to gently sloping; little runoff.
Au Gres:				
AsB	Seasonal high water table; wet depressions; sandy texture; rapid permeability; ditchbanks unstable.	Low available water capacity; very rapid water intake.	Not needed: sandy texture; level to gently sloping; little runoff.	Usually not needed: sandy texture; level to gently sloping; little runoff.
AuA	Seasonal high water table; sandy texture to a depth of 42 inches or more; moderately slow permeability below the sand.	Low available water capacity; very rapid water intake.	Not needed: sandy texture; nearly level; little runoff.	Usually not needed: sandy texture; nearly level; little runoff.
Barry: Ba	High water table; wet depressions; moderate permeability; sandy pockets.	Moderate available water capacity; rapid water intake; poor natural drainage.	No unfavorable properties. Terraces not needed: nearly level.	Not needed: nearly level.
Belding: BeA, BeB	Seasonal high water table; moderately slow permeability below a depth of 18 inches; wet depressions.	Moderate available water capacity; rapid water intake.	Not needed: nearly level to gently sloping; little runoff.	Seasonal high water table.
Belding, clay subsoil variant: BfA, BfB.	Seasonal high water table; slow permeability below a depth of 18 to 42 inches.	Low to moderate available water capacity; rapid water intake.	Dense subsoil; difficult to excavate; difficult to vegetate.	Seasonal high water table.

farm uses and selected nonfarm uses

Soil properties affecting—Continued			Limitations for use as sewage-disposal field
Farm ponds		Foundations for low buildings	
Reservoir area	Embankment		
Flood hazard; rapid seepage.	Fair stability; fair to good compaction characteristics; medium to rapid seepage; piping hazard.	Low compressibility; fair to good bearing capacity; low shrink-swell potential.	Severe: flood hazard; possible pollution of shallow water supplies. Onsite investigation needed.
High water table; rapid seepage; flotation of organic material posible. Suitable for pit-type ponds.	High water table; 18 to 42 inches of unstable organic material; sandy substratum has rapid permeability and a piping hazard.	High water table; 18 to 42 inches of unstable organic material; substratum has low shrink-swell potential and low compressibility and often flows when wet.	Severe: high water table; unstable organic material.
Medium to rapid seepage; seal blanket generally needed; sides of ponds unstable if substratum is exposed.	Poor to fair stability; medium seepage; fair to good compaction characteristics; piping hazard.	Fair to good bearing capacity; low shrink-swell potential; low compressibility; somtimes flows when wet.	Slight: when wet, soil material may flow into and plug tile lines and filter beds.
Flood hazard; rapid seepage.	Fair stability; fair to good compaction characteristics; medium seepage; piping hazard; seasonal high water table.	Fair to good bearing capacity; low shrink-swell potential; low compressibility; sometimes flows when wet; seasonal high water table.	Severe: seasonal high water table; flood hazard.
Rapid seepage in sandy layers; slow seepage in clayey substratum.	Seasonal high water table; subsoil has fair stability and medium seepage; substratum has high shrink-swell potential and slow seepage.	Seasonal high water table; poor to fair bearing capacity; high shrink-swell potential; high compressibility; low shear strength.	Severe: seasonal high water table; slow permeability at a depth of 18 to 42 inches. Onsite investigation needed.
Too porous to hold water; seal blanket necessary.	Fair stability; fair compaction characteristics; rapid seepage; hazard of piping; seasonal high water table.	Low compressibility; poor to good bearing capacity; low shrink-swell potential; seasonal high water table.	Severe: seasonal high water table; rapid percolation; possible pollution of water supplies. Onsite investigation needed.
Rapid seepage in sandy layers; slow seepage in substratum.	Sandy layers have fair stability, medium to rapid seepage, and a piping hazard. Substratum has fair to good stability, fair to good compaction characteristics, and slow seepage.	Seasonal high water table; poor to fair bearing capacity; moderate shrink-swell potential; medium compressibility; medium shear strength.	Severe: seasonal high water table; filter fields saturated in wet periods. Onsite investigation needed.
Medium seepage; high water table. Suitable for pit-type ponds.	Fair stability; fair to good compaction characteristics; medium seepage; hazard of piping; high water table.	Low compressibility; fair to good bearing capacity; low to moderate shrink-swell potential; high water table.	Severe: high water table; filter fields saturated in wet periods.
Rapid seepage in upper layers; slow seepage in substratum.	Subsoil has fair stability, medium seepage, and a piping hazard. Substratum has fair to good stability, fair to good compaction characteristics, slow seepage.	Poor to fair bearing capacity; moderate shrink-swell potential; medium compressibility; medium shear strength; seasonal high water table.	Severe: seasonal high water table; moderately slow permeability within 3 feet of the surface. Onsite investigation needed.
Rapid seepage in upper layers; slow seepage in substratum.	Seasonal high water table; fair stability; high shrink-swell potential; poor to fair compaction characteristics; slow seepage.	Seasonal high water table; poor to fair bearing capacity; high shrink-swell potential; high compressibility; low shear strength.	Severe: seasonal high water table; very slow permeability within 18 to 42 inches of the surface. Onsite investigation needed.

TABLE 7.—*Engineering interpretations for*

Soil series and map symbols	Soil properties affecting—			
	Agricultural drainage	Irrigation	Terraces and diversions	Grassed waterways
Berville: Bh	High water table; wet depressions.	Moderately high to high available water capacity; medium water intake; poor natural drainage.	No unfavorable properties. Terraces not needed: level.	Not needed: level.
Blount: BlA, BlB, BlB2	Moderately slow permeability; seasonal high water table; wet depressions.	High available water capacity; medium rate of water intake.	Dense subsoil; difficult to excavate; difficult to vegetate.	Seasonal high water table.
Borrow pits: Bp. Variable; onsite investigation needed.				
Boyer: BrA, BrB, BrC, BrD, BrE, BrF, BsA, BsB, BsC, BsD.	Not needed	Moderately low available water capacity; very rapid water intake; sloping to very steep units subject to runoff and erosion.	Moderate depth to sand and gravel; erodible; some slopes too steep or irregular.	Difficult to vegetate if cuts expose sand and gravel; sloping to very steep units subject to runoff and erosion.
Brady: BtA, BtB	Seasonal high water table; rapid permeability in substratum.	Moderate to moderately low available water capacity; rapid water intake.	Not needed: nearly level to gently sloping; little runoff.	Seasonal high water table.
Breckenridge: Bu	Moderately slow permeability below a depth of 18 inches; high water table; wet depressions.	Moderate available water capacity; rapid water intake; poor natural drainage.	No unfavorable properties. Terraces not needed: level or depressional.	Not needed: level or depressional; high water table.
Brevort: Bv	High water table; moderate permeability below a depth of 18 inches; wet depressions.	Moderate to low available water capacity; rapid water intake: poor natural drainage.	Sandy texture; difficult to vegetate. Terraces not needed: level or depressional.	Not needed: level or depressional.
Brookston: Bw	High water table; moderately slow permeability; wet depressions.	High available water capacity; medium water intake; poor natural drainage.	No unfavorable properties. Terraces not needed: level or depressional.	Not needed: level or depressional.
Capac: CaA, CaB	Moderately slow permeability; seasonal high water table; wet depressions.	High available water capacity; medium water intake.	No unfavorable properties.	Seasonal high water table.
Carlisle: Cc	High water table; organic material settles if overdrained.	Very high available water capacity; very rapid water intake; very poor natural drainage.	Unstable organic material likely to blow and fill channels. Terraces not needed: level or depressional.	Not needed: level or depressional.
Celina: CeA, CeB, CeB2	Not needed	High available water capacity; medium water intake; gently sloping units subject to erosion.	No unfavorable properties.	No unfavorable properties.

farm uses and selected nonfarm uses—Continued

Soil properties affecting—Continued			Limitations for use as sewage-disposal field
Farm ponds		Foundations for low buildings	
Reservoir area	Embankment		
High water table; medium seepage. Suitable for pit-type ponds.	High water table; fair to good stability; fair to good compaction characteristics; slow seepage.	High water table; poor to fair bearing capacity; low to moderate shrink-swell potential; medium compressibility; medium shear strength.	Severe: high water table; filter fields saturated in wet periods.
Medium to slow seepage	Fair to good stability; fair to good compaction characteristics; slow seepage.	Seasonal high water table; poor to fair bearing capacity; moderate shrink-swell potential; medium compressibility; medium shear strength.	Severe: seasonal high water table; moderately slow permeability within 2 feet of the surface.
Medium to rapid seepage in subsoil; seal blanket necessary if substratum is exposed.	Subsoil has fair stability, medium seepage, and fair to good compaction characteristics; substratum has good stability, rapid seepage, and a hazard of piping.	Good bearing capacity; low shrink-swell potential; very low compressibility; medium to high shear strength.	Slight: very rapid permeability at a depth of about 2½ feet; some slopes of more than 10 percent; possible pollution of shallow water supplies.
Medium seepage in subsoil; seal blanket necessary if substratum is exposed.	Subsoil has fair to good stability, slow seepage, and fair to good compaction characteristics; substratum has fair stability, rapid seepage, and fair compaction characteristics.	Seasonal high water table; fair to good bearing capacity; low shrink-swell potential; very low compressibility; medium to high shear strength; flows when wet.	Moderate to severe: seasonal high water table; very rapid permeability at a depth of about 4 feet; possible pollution of shallow water supplies. Onsite investigation needed.
High water table; medium seepage. Suitable for pit-type ponds.	High water table; fair to good stability; fair to good compaction characteristics; slow seepage.	High water table; poor to fair bearing capacity; moderate shrink-swell potential; medium compressibility; medium shear strength.	Severe: high water table; moderately slow permeability within 2½ feet of the surface.
High water table; rapid seepage in upper layers; slow seepage in substratum. Suitable for pit-type ponds.	High water table; subsoil has fair stability and a hazard of piping; substratum has fair to good stability, fair to good compaction characteristics, and slow seepage.	High water table; poor to fair bearing capacity; moderate shrink-swell potential; medium compressibility; medium shear strength.	Severe: high water table; filter fields saturated in wet periods.
High water table; slow to medium seepage. Suitable for pit-type ponds.	High water table; fair to good stability; fair to good compaction characteristics; slow seepage.	High water table; poor to fair bearing capacity; moderate shrink-swell potential; medium compressibility; tendency to liquify.	Severe; high water table; moderately slow permeability.
Slow to medium seepage	Fair to good stability; fair to good compaction characteristics; slow seepage.	Seasonal high water table; poor to fair bearing capacity; hazard of frost heave; tendency to liquefy; moderate shrink-swell potential.	Severe: seasonal high water table; variable permeability below a depth of 3 feet. Onsite investigation needed.
High water table; rapid seepage; flotation of organic material possible. Suitable for pit-type ponds.	High water table; unstable organic material.	High water table; very high compressibility; instability.	Severe: high water table; unstable organic material.
Fair stability; fair compaction characteristics; slow seepage.	Fair stability; fair compaction characteristics; slow seepage.	Poor to fair bearing capacity; moderate shrink-swell potential; medium shear strength; medium compressibility.	Moderate to severe: moderately slow permeability; temporary seasonal high high water table.

TABLE 7.—*Engineering interpretations for*

Soil series and map symbols	Soil properties affecting—			
	Agricultural drainage	Irrigation	Terraces and diversions	Grassed waterways
Ceresco: Cf	Seasonal high water table; flood hazard.	Moderate available water capacity; rapid water intake; flood hazard.	Not needed: nearly level.	Not needed: nearly level.
Chelsea: ChB, ChC, ChD	Not needed	Low available water capacity; very rapid water intake; hazard of soil blowing.	Not needed: sandy texture; slow to medium runoff.	Usually not needed: sandy texture; slow to medium runoff.
Cohoctah: Cm	High water table; flood hazard.	Moderate available water capacity; rapid water intake; flood hazard; poor natural drainage.	No unfavorable properties. Terraces not needed: nearly level.	Not needed: nearly level.
Colwood: Co	High water table; silt and very fine sand in substratum can flow into tile; ditchbanks unstable.	High available water capacity; rapid water intake; poor natural drainage.	Siltation of channels likely. Terraces not needed: level or depressional.	Not needed: level or depressional.
Conover: CvA, CvB	Moderately slow permeability; seasonal high water table; wet depressions.	High available water capacity; medium water intake.	No unfavorable properties. Terraces not needed.	Seasonal high water table.
Del Rey: DrA, DrB	Moderately slow permeability; seasonal high water table; wet depressions.	High available water capacity; medium water intake.	Dense subsoil; difficult to excavate; difficult to vegetate. Terraces not needed: level to gently sloping; little runoff.	Seasonal high water table.
Dryden: DyA, DyB	Not needed	Moderate available water capacity; rapid water intake.	No unfavorable properties.	Stones in places
Edwards: Ed	High water table; moderate depth to marl; organic material settles if overdrained.	High available water capacity; very rapid water intake; very poor natural drainage.	Unstable organic material and marl likely to blow and fill channels. Terraces not needed: level or depressional.	Not needed: level or depressional.
Fabius: FaA, FaB For Wasepi part of these mapping units, see Wasepi series.	Seasonal high water table; sand and gravel substratum.	Moderately low available water capacity; rapid water intake; shallow to sand and gravel.	Not needed: nearly level to gently sloping; little runoff.	Difficult to vegetate if substratum is exposed.
Fox: FoA, FoB, FoC2	Not needed	Moderate available water capacity; rapid water intake; moderately sloping unit subject to runoff and erosion.	Short, irregular slopes in some areas.	Difficult to vegetate if substratum is exposed in cuts; moderately sloping unit subject to runoff and erosion.

farm uses and selected nonfarm uses—Continued

Soil properties affecting—Continued			Limitations for use as sewage-disposal field
Farm ponds		Foundations for low buildings	
Reservoir area	Embankment		
Rapid seepage; flood hazard.	Seasonal high water table; fair stability; fair to good compaction characteristics; medium seepage; hazard of piping.	Seasonal high water table; fair to good bearing capacity; low shrink-swell potential; low compressibility; tendency to liquify and flow when wet.	Severe: seasonal high water table; flood hazard. Onsite investigation needed.
Rapid seepage; too porous to hold water; seal blanket necessary.	Medium to rapid seepage; fair stability; fair compaction characteristics; hazard of piping; low shrink-swell potential.	Fair to good bearing capacity; low shrink-swell potential; low compressibility; tendency to liquify and flow when wet.	Slight: possible pollution of water supplies; some slopes of more than 10 percent.
High water table; rapid seepage; flood hazard. Suitable for pit-type ponds.	High water table; fair stability; fair to good compaction characteristics; medium seepage; hazard of piping.	High water table; fair to good bearing capacity; low shrink-swell potential; low compressibility; medium to high shear strength; flood hazard.	Severe: high water table; flood hazard; variable permeability.
High water table; medium seepage. Suitable for pit-type ponds, but sides would be unstable when wet.	High water table; subsoil has fair stability and slow seepage; substratum has poor stability, medium seepage, and a hazard of piping.	High water table; poor bearing capacity; tendency to liquefy; low shrink-swell potential; low compressibility; medium shear strength.	Severe: high water table; moderately slow permeability within 3 feet of the of the surface.
Slow to medium seepage	Fair to good stability; fair to good compaction characteristics; slow seepage.	Seasonal high water table; poor to fair bearing capacity; low shrink-swell potential; medium compressibility; medium shear strength.	Severe: seasonal high water table; moderately slow permeability; filter fields saturated in wet periods. Onsite investigation needed.
Slow to medium seepage	Fair to good stability; fair to good compaction characteristics; slow seepage.	Medium compressibility; poor to fair bearing capacity; moderate shrink-swell potential; seasonal high water table; substratum unstable when wet.	Severe: seasonal high water table; moderately slow permeability. Onsite investigation needed.
Medium seepage in subsoil; medium to rapid seepage in substratum.	Subsoil has fair stability, slow seepage, and good compaction characteristics; substratum has fair stability, fair compaction characteristics, and medium seepage.	Fair to good bearing capacity; low shrink-swell potential; low compressibility; tendency to liquify and flow when wet.	Moderate: temporary seasonal high water table. Onsite investigation needed.
High water table; rapid seepage; flotation of organic material possible. Suitable for pit-type ponds.	High water table; organic material unstable; underlying marl has poor stability and poor compaction characteristics.	High water table; very high compressibility; instability; underlying marl has poor bearing capacity and low shear strength.	Severe: high water table; unstable organic material; marl at a depth of 1 to 3½ feet.
Medium seepage in subsoil; seal blanket necessary if substratum is exposed.	Subsoil has fair to good stability, fair to good compaction characteristics, and slow seepage; substratum has fair stability, fair compaction characteristics, and rapid seepage.	Seasonal high water table; good bearing capacity; low shrink-swell potential; low compressibility; high shear strength.	Moderate to severe: seasonal high water table; possible pollution of water supplies because of rapid percolation in substratum. Onsite investigation needed.
Slow to medium seepage in subsoil; seal blanket necessary if substratum is exposed.	Subsoil has fair stability, slow seepage, and fair compaction characteristics; substratum has good stability and rapid seepage.	Good bearing capacity; low shrink-swell potential; low compressibility; medium to high shear strength.	Slight: rapid permeability at a depth of 2½ feet; possible pollution of shallow water supplies.

TABLE 7.—*Engineering interpretations for*

Soil series and map symbols	Soil properties affecting—			
	Agricultural drainage	Irrigation	Terraces and diversions	Grassed waterways
Gilford: Gd	High water table: moderately rapid permeability at depth of about 3 feet; rapid permeability below that depth; sandy substratum.	Low to moderate available water capacity; rapid water intake; poor natural drainage.	No unfavorable properties. Terraces not needed: level.	Not needed: level
Glendora: Ge	Normally not suitable for crops.	Moderately low available water capacity; very rapid water intake; flood hazard; poor natural drainage.	Not needed: nearly level.	Not needed: nearly level.
Granby: Gm, Gn	High water table; sandy substratum; wet depressions; ditchbanks unstable.	Low available water capacity; rapid water intake; poor natural drainage.	Erodible; difficult to vegetate. Terraces not needed: level or depressional.	Not needed: level or depressional.
Gravel pits: Gr. Variable; onsite investigation needed.				
Greenwood Mapped only with Spalding soils.	High water table; organic material settles if overdrained.	High available water capacity; very rapid water intake; very high acidity; very poor natural drainage.	Unstable organic material. Terraces not needed: level or depressional.	Not needed: level or depressional.
Gullied land: Gs, Gu. Variable; onsite investigation needed.				
Houghton: Ho	High water table; organic material settles if overdrained.	High available water capacity; very rapid water intake; very poor natural drainage.	Unstable organic material likely to blow and fill channels. Terraces not needed: level or depressional.	Not needed: level or depressional.
Hoytville: Ht, Hy	High water table; very slow permeability.	High available water capacity; slow water intake; poor natural drainage.	Dense, clayey subsoil; difficult to excavate; difficult to vegetate. Terraces not needed: level.	Clayey subsoil; high water table.
Iosco: IoA	Moderately slow permeability below a depth of 18 inches; seasonal high water table; wet depressions.	Moderately low available water capacity; very rapid water intake; moderately slow permeability below a depth of 18 inches.	Not needed: sandy texture; nearly level; little runoff.	Not needed: sandy texture; nearly level; little runoff.
Kibbie: KbA, KbB	High water table; silt and very fine sand in substratum can flow into tile; ditchbanks unstable.	Moderate to moderately high available water capacity; medium to moderately rapid water intake.	Erodible; siltation of channels likely. Terraces not needed: nearly level to gently sloping; little runoff.	Not needed: nearly level to gently sloping; little runoff.
Lapeer: LaA, LaB, LaB2, LaC, LaC2, LaC3, LaD2, LaD3, LaE2, LaE3, LaF.	Not needed	Moderate available water capacity; rapid water intake.	Short, irregular slopes and slopes of more than 12 percent in places.	Stones in some areas

farm uses and selected nonfarm uses—Continued

Soil properties affecting—Continued			Limitations for use as sewage-disposal field
Farm ponds		Foundations for low buildings	
Reservoir area	Embankment		
High water table; rapid seepage in substratum. Suitable for pit-type ponds.	High water table; subsoil has fair to good stability and slow seepage; substratum has fair stability, rapid seepage, and a hazard of piping.	High water table; fair to good bearing capacity; low shrink-swell potential; low compressibility; flows when wet.	Severe: high water table; filter fields saturated in wet periods.
High water table; rapid seepage; flood hazard. Suitable for pit-type ponds.	High water table; fair stability; fair to good compaction characteristics; rapid seepage; hazard of piping.	High water table; good bearing capacity; low shrink-swell potential; low compressibility; medium to high shear strength; flood hazard.	Severe: high water table; flood hazard.
High water table; rapid seepage. Suitable for pit-type ponds.	High water table; fair stability; fair compaction characteristics; rapid seepage; hazard of piping.	High water table; fair to good bearing capacity; low shrink-swell potential; low compressibility; high shear strength; flows when wet.	Severe: high water table; filter fields saturated in wet periods.
High water table; rapid seepage; flotation of organic material possible. Suitable for pit-type ponds.	High water table; unstable organic material.	High water table; very high compressibility; instability.	Severe: high water table; unstable organic material.
High water table; rapid seepage; flotation of organic material possible. Suitable for pit-type ponds.	High water table; unstable organic material.	High water table; very high compressibility; instability.	Severe: high water table; unstable organic material.
High water table; slow seepage. Suitable for pit-type ponds.	High water table; fair stability; poor compaction characteristics; slow seepage; high shrink-swell potential.	High water table; poor to fair bearing capacity; high shrink-swell potential; high compressibility; low shear strength; hard when dry.	Severe: high water table; very slow permeability within 3 feet of the surface.
Rapid seepage in sandy layers; slow seepage in substratum.	Sandy layers have fair stability, rapid seepage, and a hazard of piping; substratum has fair to good stability, fair to good compaction characteristics, and slow seepage.	Seasonal high water table; poor to fair bearing capacity; low to moderate shrink-swell potential; medium compressibility; medium shear strength.	Severe: seasonal high water table; moderately slow permeability within 18 to 42 inches of the surface. Onsite investigation needed.
Slow to rapid seepage; sides of ponds unstable when wet.	Subsoil has fair stability, fair compaction characteristics, and slow seepage; substratum has poor stability, medium seepage, and a hazard of piping.	Seasonal high water table; poor bearing capacity; tendency to liquify; low shrink-swell potential.	Severe: seasonal high water table; tendency to flow when wet; can plug tile and filter fields. Onsite investigation needed.
Medium seepage in subsoil; medium to rapid seepage in substratum.	Substratum has fair stability, slow seepage, and good compaction characteristics; substratum has fair stability, fair compaction characteristics, and medium seepage.	Fair to good bearing capacity; low shrink-swell potential; low compressibility.	Slight: some units have slopes of more than 10 percent.

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TABLE 7.—*Engineering interpretations for*

Soil series and map symbols	Soil properties affecting—			
	Agricultural drainage	Irrigation	Terraces and diversions	Grassed waterways
Lenawee: Le	High water table; moderately slow permeability; wet depressions.	High available water capacity; medium water intake; poor natural drainage.	No unfavorable properties. Terraces not needed: level or depressional.	Not needed: level or depressional.
Linwood: Lm	High water table; organic material settles if overdrained.	High available water capacity; very rapid water intake; very poor natural drainage.	Unstable organic material likely to blow and fill channels. Terraces not needed: level or depressional.	Not needed: level or depressional.
Locke: LoA, LoB	Seasonal high water table; moderate permeability; sandy pockets.	Moderate available water capacity; rapid water intake.	No unfavorable properties. Terraces not needed: level to gently sloping; little runoff.	Seasonal high water table.
Lupton: Lu	High water table; organic material settles if overdrained.	High available water capacity; very rapid water intake; very poor natural drainage.	Unstable organic material likely to blow and fill channels. Terraces not needed: level or depressional.	Not needed: level or depressional.
Macomb: MaA, MaB	Moderate permeability below a depth of 18 inches; seasonal high water table; wet depressions.	Moderate available water capacity; medium water intake.	No unfavorable properties. Terraces not needed; level to gently sloping; little runoff.	Seasonal high water table.
Made land: Md. Variable; onsite investigation needed.				
Mancelona: MeB, MeC2	Not needed	Moderately low available water capacity; very rapid water intake; hazard of soil blowing.	Sandy texture; erosion hazard; difficult to vegetate.	Sandy texture; erosion hazard; difficult to vegetate.
Marlette: MfA, MfB, MfB2, MfC, MfC2, MfC3, MfD2, MfD3, MfE2, MfF2.	Not needed, except in small wet areas.	High available water capacity; medium water intake.	Short, irregular slopes in some areas; some units have slopes of more than 12 percent.	No unfavorable properties.
Matherton: MhA, MhB	Seasonal high water table; moderate permeability above a depth of 3 feet; very rapid permeability at greater depth.	Moderate available water capacity; rapid water intake; moderate depth to sand and gravel.	No unfavorable properties. Terraces not needed: level to gently sloping; little runoff.	Not needed: level to gently sloping; little runoff.
McBride: MkB, MkB2, MkC2, MlA, MlB, MlB2, MlC, MlC2, MlC3, MlD, MlD2, MlD3, MlE2, MlF.	Not needed	Moderate available water capacity; rapid water intake; fragipan at a depth of 18 to 30 inches; sloping to very steep units subject to runoff and erosion.	Fragipan at a depth of 18 to 30 inches; some units have slopes of more than 12 percent.	Sloping to very steep units subject to runoff and erosion.

farm uses and selected nonfarm uses—Continued

Soil properties affecting—Continued			Limitations for use as sewage-disposal field
Farm ponds		Foundations for low buildings	
Reservoir area	Embankment		
High water table; slow seepage. Suitable for pit-type ponds.	High water table; fair to good stability; fair to good compaction characteristics; slow seepage.	High water table; poor to fair bearing capacity; moderate shrink-swell potential; medium compressibility; medium shear strength.	Severe: high water table; moderately slow permeability within 2 feet of the surface.
High water table; rapid seepage in organic layer; slow seepage in lower part; flotation of organic material possible. Suitable for pit-type ponds.	High water table; 18 to 42 inches of unstable organic material; substratum has poor compaction characteristics and poor stability.	High water table; 18 to 42 inches of unstable organic material; substratum has poor bearing capacity and low shear strength.	Severe: high water table; unstable organic material.
Medium seepage	Fair stability; fair to good compaction characteristics; slow seepage.	Seasonal high water table; fair to good bearing capacity; low to moderate shrink-swell potential; low compressibility; medium shear strength; tendency to flow when wet.	Severe: seasonal high water table; moderate permeability. Onsite investigation needed.
High water table; rapid seepage; flotation of organic material possible. Suitable for pit-type ponds.	High water table; unstable organic material.	High water table; very high compressibility; unstable organic material.	Severe: high water table; unstable organic material.
Slow to medium seepage	Fair to good stability; fair to good compaction characteristics; slow seepage.	Seasonal high water table; poor to fair bearing capacity; low shrink-swell potential; medium compressibility; medium shear strength.	Severe: seasonal high water table; moderate permeability. Onsite investigation needed.
Rapid seepage above a depth of 42 to 66 inches; slow seepage at greater depths; seal blanket necessary unless sandy material is removed.	Subsoil has fair stability, medium seepage, and good compaction characteristics; substratum has slow seepage and fair to good compaction characteristics.	Poor to fair bearing capacity; moderate shrink-swell potential; low shear strength; medium to high compressibility.	Slight: moderately slow permeability below a depth of 4 feet.
Slow to medium seepage	Fair to good stability; slow seepage; fair compaction characteristics.	Poor to fair bearing capacity; low shrink-swell potential; medium shear strength.	Moderate to severe: moderately slow permeability in subsoil; some units have slopes of more than 10 percent.
Medium seepage in subsoil; seal blanket necessary if substratum is exposed.	Subsoil has fair to good stability, fair to good compaction characteristics, and slow seepage; substratum has fair stability, fair compaction characteristics, and rapid seepage.	Seasonal high water table; good bearing capacity; low shrink-swell potential; low compressibility; high shear strength.	Severe: seasonal high water table; rapid percolation in substratum; possible pollution of water supplies. Onsite investigation neeced.
Medium to rapid seepage; seal blanket usually necessary.	Fair stability; fair to good compaction characteristics; medium seepage.	Fair to good bearing capacity; low shrink-swell potential; low compressibility.	Slight: some units have slopes of more than 10 percent; strong fragipan at a depth of 18 to 30 inches in some areas. Onsite investigation needed.

TABLE 7.—*Engineering interpretations for*

Soil series and map symbols	Soil properties affecting—			
	Agricultural drainage	Irrigation	Terraces and diversions	Grassed waterways
Menominee: MmA, MmB, MmC, MmD.	Not needed, except in small wet areas.	Moderately low available water capacity; very rapid water intake; sloping to moderately steep units subject to erosion.	Sandy, erodible subsoil; difficult to vegetate; some units have slopes of more than 12 percent.	Sandy texture; difficult to vegetate; sloping to moderately steep units subject to erosion.
Metamora: MnA, MnB	Seasonal high water table; moderately slow permeability below a depth of 18 to 42 inches; wet depressions.	Moderate available water capacity; rapid water intake.	Not needed: level to gently sloping; little runoff.	Seasonal high water table.
Miami: MoB, MoB2, MoC, MoC2, MoD, MoD2, MoE, MoE2, MoF, MoF2, MpC3, MpD3, MpE3, MpF3.	Not needed	High available water capacity; medium rate of water intake; sloping to very steep units subject to erosion.	Short, irregular slopes and slopes of more than 12 percent in some areas.	Stones in some areas; sloping to very steep units subject to runoff and erosion.
Montcalm: MrA, MrB, MrC, MrD, MrE, MrF, MsA, MsB.	Not needed	Moderately low available water capacity; very rapid water intake; hazard of soil blowing.	Short, irregular slopes and slopes of more than 12 percent in some areas. Sandy; erodible; difficult to vegetate.	Erosion hazard on moderate to very steep units; difficult to vegetate. Not needed on level to gently sloping units.
Morley: MtB, MtB2, MtC, MtC2, MtD2, MuC3, MuD3, MuE3.	Not needed, except in small wet areas.	High available water capacity; medium water intake.	Subsoil clayey in places; difficult to vegetate; short, irregular slopes and slopes of more than 12 percent in some areas.	Subsoil clayey in places; difficult to vegetate.
Munuscong: Mv	High water table; slow permeability below a depth of 18 to 42 inches.	Moderate available water capacity; rapid water intake; poor natural drainage.	Dense, clayey material at a depth of 18 to 42 inches. Terraces not needed: nearly level or depressional.	Not needed: nearly level or depressional.
Mussey: Mw For Gilford part of this mapping unit, see Gilford series.	High water table; moderate permeability above a depth of 2 feet; very rapid permeability below that depth.	Moderate available water capacity; medium water intake; poor natural drainage.	No unfavorable properties. Terraces not needed: level or depressional.	Not needed: nearly level or depressional.
Nappanee: NaA, NaB, NpA, NpB2.	Seasonal high water table; very slow permeability.	High available water capacity; medium water intake; very slow permeability.	Dense, clayey subsoil; difficult to excavate; difficult to vegetate.	Cuts expose clayey material; difficult to vegetate.
Oshtemo: OsA, OsB, OsC.	Not needed	Moderately low available water capacity; very rapid water intake.	No unfavorable properties.	No unfavorable properties.

farm uses and selected nonfarm uses—Continued

Soil properties affecting—Continued			Limitations for use as sewage-disposal field
Farm ponds		Foundations for low buildings	
Reservoir area	Embankment		
Rapid seepage above a depth of 18 to 42 inches; slow seepage at greater depth; seal blanket necessary unless sandy material is removed.	Sandy material has fair stability, medium seepage, and a hazard of piping; substratum has fair to good stability and slow seepage.	Fair bearing capacity; low to moderate shrink-swell potential; medium shear strength; medium compressibility.	Slight to moderate: moderately slow permeability at a depth of 2 to 4 feet; some units have slopes of more than 10 percent. Onsite investigation needed.
Slow to medium seepage	Fair to good stability; fair to good compaction characteristics; slow seepage.	Seasonal high water table; poor to fair bearing capacity; low to moderate shrink-swell potential; tendency to liquefy.	Severe: seasonal high water table; variable permeability. Onsite investigation needed.
Slow to medium seepage	Fair stability; fair compaction characteristics: slow seepage; low to moderate shrink-swell potential.	Poor to fair bearing capacity; low to moderate shrink-swell potential; medium shear strength.	Moderate to severe: moderately slow permeability in substratum; some units have slopes of more than 10 percent.
Rapid seepage; too porous to hold water; seal blanket necessary.	Medium to rapid seepage; fair stability; fair compaction characteristics; hazard of piping; low shrink-swell potential.	Fair to good bearing capacity; low shrink-swell potential; low compressibility.	Slight: possible pollution of water supplies; some units have slopes of more than 10 percent.
Slow seepage	Fair stability; fair compaction characteristics; slow seepage; high shrink-swell potential.	Poor to fair bearing capacity; moderate to high shrink-swell potential; medium shear strength; medium compressibility.	Severe: moderately slow permeability; some units have slopes of more than 10 percent. Onsite investigation needed.
High water table; slow seepage. Suitable for pit-type ponds.	High water table; subsoil has fair stability and medium seepage; substratum has fair stability, high shrink-swell potential, and slow seepage.	High water table; poor to fair bearing capacity; high shrink-swell potential; high compressibility; low shear strength; hard when dry.	Severe: high water table; slow permeability within 18 to 42 inches of the surface.
High water table; rapid seepage in substratum. Suitable for pit-type ponds.	High water table; subsoil has fair to good stability and slow seepage; substratum has fair stability, rapid seepage, and a piping hazard.	High water table; good bearing capacity; low shrink-swell potential; very low compressibility; high shear strength.	Severe: high water table; filter fields saturated in wet periods.
Slow seepage	Seasonal high water table; fair stability; high shrink-swell potential; poor to fair compaction characteristics; slow seepage.	Seasonal high water table; poor bearing capacity; high shrink-swell potential; high compressibility; low shear strength; hard when dry.	Severe: seasonal high water table; very slow permeability in clayey subsoil. Onsite investigation needed.
Medium to rapid seepage in subsoil; seal blanket necessary if substratum is exposed.	Subsoil has fair stability, medium seepage, and fair to good compaction characteristics; substratum has good stability, rapid seepage, and very low compressibility.	Good bearing capacity; low shrink-swell potential; very low compressibility; medium to high shear strength.	Slight: possible pollution of shallow water supplies.

TABLE 7.—*Engineering interpretations for*

Soil series and map symbols	Soil properties affecting—			
	Agricultural drainage	Irrigation	Terraces and diversions	Grassed waterways
Owosso: OwA, OwB, OwC, OwC2.	Not needed, except in small wet areas.	Moderate available water capacity; very rapid water intake.	No unfavorable properties.	Not needed: sandy texture; little runoff.
Paulding: Pa	High water table; very slow permeability.	Moderately high available water capacity; slow water intake; poor natural drainage.	Dense, very clayey subsoil; difficult to excavate; difficult to vegetate. Terraces not needed: level or depressional.	Clayey subsoil; high water table.
Pewamo: Pe, Pm	High water table; moderately slow permeability; wet depressions.	High available water capacity; medium water intake; poor natural drainage.	Dense, clayey subsoil; difficult to excavate; difficult to vegetate. Terraces not needed: level or depressional.	Not needed: level or depressional.
Pinconning: Pn	High water table; very slow permeability below a depth of 18 inches.	Moderately low available water capacity; rapid water intake; poor natural drainage.	Sandy; difficult to vegetate. Terraces not needed: level or depressional.	Not needed: level or depressional.
Richter: RcA, RcB	Seasonal high water table; wet depressions; silty and sandy material can flow into tile; ditchbanks unstable.	Moderate available water capacity; medium water intake.	Not needed: level to gently sloping; little runoff.	Seasonal high water table.
Roselms: RoA, RoB, RoB2.	High water table; very slow permeability.	Moderately high available water capacity; slow water intake; somewhat poor natural drainage.	Clayey; difficult to excavate; difficult to vegetate.	Clayey subsoil; high water table; construction and seeding difficult.
St. Clair: ScB2, ScC2	Not needed, except in small wet areas.	High available water capacity; medium water intake; very slow permeability; moderately sloping unit subject to runoff and erosion.	Dense and clayey; difficult to excavate; difficult to vegetate; short, irregular slopes.	Dense, clayey subsoil; difficult to vegetate; moderately sloping unit subject to runoff and erosion.
Sebewa: Se	High water table; very rapid permeability below a depth of 3 feet; sand and gravel substratum; wet depressions.	Moderate available water capacity; medium water intake; poor natural drainage.	No unfavorable properties. Terraces not needed: level or depressional.	Not needed: level or depressional.
Sisson: SfB, SfB2, SfC, SfC2.	Not needed	Moderately high available water capacity; medium water intake.	Moderate depth to highly erodible silt and sand; short, irregular slopes in some areas.	Moderately sloping units erode readily.
Sloan: Sn	High water table; flood hazard.	High available water capacity; medium rate of water intake; flood hazard; poor natural drainage.	No unfavorable properties. Terraces not needed: level or depressional.	Not needed: nearly level or depressional.

farm uses and selected nonfarm uses—Continued

Soil properties affecting—Continued			Limitations for use as sewage-disposal field
Farm ponds		Foundations for low buildings	
Reservoir area	Embankment		
Rapid seepage above a depth of 18 to 42 inches; slow seepage at greater depth; seal blanket necessary unless sandy material is removed.	Subsoil has fair stability, medium seepage, and good compaction characteristics; substratum has fair to good compaction characteristics and slow seepage.	Poor to fair bearing capacity; moderate shrink-swell potential; medium shear strength; medium compressibility.	Moderate to severe: moderately slow permeability below a depth of 2 to 3 feet. Onsite investigation needed.
High water table; slow seepage. Suitable for pit-type ponds.	High water table; fair stability; poor compaction characteristics; slow seepage; high shrink-swell potential.	High water table; poor to fair bearing capacity; high shrink-swell potential; high compressibility; low shear strength; hard when dry.	Severe: high water table; very slow permeability within 2 feet of the surface.
High water table; slow seepage. Suitable for pit-type ponds.	High water table; fair to good stability; fair to good compaction characteristics; slow seepage.	High water table; poor to fair bearing capacity; moderate to high shrink-swell potential; medium compressibility; medium shear strength.	Severe: high water table; moderately slow permeability within 2 feet of the surface.
High water table; slow seepage. Suitable for pit-type ponds.	High water table; upper part of substratum (18 to 42 inches) has fair stability and rapid seepage; lower part has fair stability, slow seepage, and high shrink-swell potential.	High water table; poor to fair bearing capacity; high shrink-swell potential; high compressibility; low shear strength; hard when dry.	Severe: high water table; very slow permeability within 3 feet of the surface.
Medium to rapid seepage; sides of ponds unstable when wet.	Fair stability; good compaction characteristics; medium seepage; hazard of piping.	Seasonal high water table; fair bearing capacity; tendency to liquify; low shrink-swell potential.	Severe: seasonal high water table; filter fields saturated in wet periods. Onsite investigation needed.
Seasonal high water table; slow seepage. Suitable for pit-type ponds.	Seasonal high water table; fair stability; poor compaction characteristics; slow seepage; high shrink-swell potential.	Seasonal high water table; poor to fair bearing capacity; high shrink-swell potential; high compressibility; low shear strength; hard when dry.	Severe: high water table; very slow permeability within 2 feet of the surface.
Slow seepage	Fair stability; slow seepage; poor to fair compaction characteristics; high shrink-swell potential.	Poor to fair bearing capacity; high shrink-swell potential; high compressibility; low shear strength; hard when dry.	Severe: temporary seasonal high water table; very slow permeability within 1 foot of the surface.
High water table; rapid seepage in substratum. Suitable for pit-type ponds.	High water table; subsoil has fair to good stability and slow seepage; substratum has fair stability, rapid seepage, and a hazard of piping.	High water table; good bearing capacity; low shrink-swell potential; very low compressibility; good shear strength.	Severe: high water table; filter fields saturated in wet periods.
Medium seepage; seal blanket necessary and sides of ponds unstable if substratum is exposed.	Subsoil has fair to good stability, slow seepage, and fair compaction characteristics; substratum has poor to fair stability and a hazard of piping.	Poor to fair bearing capacity; hazard of frost heave and reduction in bearing capacity upon thawing; tendency to flow when wet; low shrink-swell potential.	Slight: tendency to flow when wet.
High water table; flood hazard; slow seepage. Suitable for pit-type ponds.	High water table; fair to good stability; fair to good compaction characteristics; slow seepage.	High water table; poor to fair bearing capacity; medium compressibility; medium shear strength.	Severe: high water table; flood hazard; variable permeability.

TABLE 7.—*Engineering interpretations for*

Soil series and map symbols	Soil properties affecting—			
	Agricultural drainage	Irrigation	Terraces and diversions	Grassed waterways
Spalding: So—For Greenwood part of this mapping unit, see Greenwood series.	High water table; organic material settles if overdrained.	High available water capacity; very rapid water intake; strongly acid; very poor natural drainage.	Unstable organic material. Terraces not needed: level or depressional.	Not needed: level or depressional.
Spinks: SpA, SpB, SpC SpD, SpE, SpF.	Not needed	Moderately low available water capacity; rapid water intake; hazard of soil blowing.	Short, irregular slopes and slopes of more than 12 percent in some areas; difficult to vegetate.	Moderately sloping to very steep units erodible and difficult to vegetate. Not needed on level and gently sloping units.
Tawas: Ta	High water table; sandy substratum; ditchbanks unstable.	High available water capacity; very rapid water intake; very poor natural drainage.	Unstable organic material and sand likely to blow and fill channels. Terraces not needed: level or depressional.	Not needed: level or depressional.
Tedrow: TeA, TeB	Seasonal high water table; sandy substratum; wet depressions.	Moderately low available water capacity; very rapid water intake.	Not needed: level to gently sloping; sandy texture; little runoff.	Not needed: level to gently sloping; sandy texture; little runoff.
Tonkey: To	High water table; wet depressions; sandy material in substratum can flow into tile; ditchbanks unstable.	Moderate available water capacity; rapid water intake; poor natural drainage.	Siltation of channels likely. Terraces not needed: level or depressional.	Not needed: nearly level or depressional.
Tuscola: TuA, TuB	Not needed	High available water capacity; medium rate of water intake.	Moderate depth to highly erodible silt and sand. Siltation of channels likely.	Gently sloping unit subject to erosion.
Ubly: UbA, UbB	Not needed	Moderate available water capacity; rapid water intake.	No unfavorable properties.	No unfavorable properties.
Warners: Wb	High water table; shallow over marl.	High water table; shallow over marl; very poor natural drainage.	Unstable organic material over unstable marl. Terraces not needed: level or depressional.	Not needed: level or depressional.
Wasepi: WsA, WsB	Seasonal high water table; sand and gravel substratum.	Low to moderate available water capacity; rapid water intake; moderate depth to sand and gravel.	No unfavorable properties. Terraces not needed: level to gently sloping; little runoff.	Not needed: level to gently sloping; little runoff.
Willette: Wt	High water table; organic material settles if overdrained.	High available water capacity; very rapid water intake; very poor natural drainage.	Unstable organic material likely to blow; dense, clayey material at a depth of 18 to 42 inches is difficult to excavate and difficult to vegetate. Terraces not needed: level or depressional.	Not needed: level or depressional.

farm uses and selected nonfarm uses—Continued

Soil properties affecting—Continued			Limitations for use as sewage-disposal field
Farm ponds		Foundations for low buildings	
Reservoir area	Embankment		
High water table; rapid seepage; flotation of organic material possible. Suitable for pit-type ponds.	High water table; unstable organic material.	High water table; very high compressibility; unstable organic material.	Severe: high water table; unstable organic material.
Rapid seepage; too porous to hold water; seal blanket necessary.	Medium to rapid seepage; fair stability; fair compaction characteristics; hazard of piping; low shrink-swell potential.	Good bearing capacity; low shrink-swell potential; very low compressibility.	Slight: possible pollution of water supplies; some units have slopes of more than 10 percent.
High water table; rapid seepage; flotation of organic material possible. Suitable for pit-type ponds.	High water table; 18 to 42 inches of unstable organic material; rapid permeability and hazard of piping in sandy substratum.	High water table; 18 to 42 inches of unstable organic material; substratum has low shrink-swell potential, low compressibility, and tendency to flow when wet.	Severe: high water table; unstable organic material.
Too porous to hold water; seal blanket necessary.	Subsoil has fair stability and medium seepage; substratum has fair stability, fair compaction characteristics, rapid seepage, and a hazard of piping.	Seasonal high water table; fair to good bearing capacity; low shrink-swell potential; very low compressibility; medium shear strength; flows when wet.	Severe: seasonal high water table; filter beds saturated in wet periods. Onsite investigation needed.
High water table; medium seepage. Suitable for pit-type ponds, but sides would be unstable when wet.	High water table; fair stability; medium seepage; hazard of piping.	High water table; poor to fair bearing capacity when wet; tendency to liquify; low shrink-swell potential; low compressibility; medium shear strength.	Severe: high water table; filter beds saturated in wet periods.
Medium seepage; seal blanket necessary and sides of pond unstable if substratum is exposed.	Subsoil has fair to good stability, slow seepage, and fair compaction characteristics; substratum has poor to fair stability and a hazard of piping.	Poor to fair bearing capacity; hazard of frost heave and reduction of bearing capacity upon thawing; tendency to flow when wet.	Slight to moderate: temporary seasonal high water table; tendency to flow when wet. Onsite investigation needed.
Rapid seepage above a depth of 18 to 42 inches; medium to slow seepage at greater depths; seal blanket necessary unless sandy material is removed.	Fair stability; fair compaction characteristics; slow seepage; moderate shrink-swell potential.	Poor to fair bearing capacity; moderate shrink-swell potential; medium shear strength; medium compressibility.	Slight: temporary high water table in some areas in wet periods. Onsite investigation needed.
High water table; rapid seepage; flotation of organic material possible. Suitable for pit-type ponds.	High water table; unstable organic material over unstable marl.	High water table; very high compressibility; unstable organic material over unstable marl.	Severe: high water table; thin layer of unstable organic material over unstable marl.
Medium seepage in subsoil; seal blanket necessary if substratum is exposed.	Subsoil has fair stability, medium seepage, and fair to good compaction characteristics; substratum has fair stability, fair compaction characteristics, and rapid seepage.	Seasonal high water table; fair to good bearing capacity; low shrink-swell potential; very low compressibility; medium to high shear strength; flows when wet.	Severe: high water table. Onsite investigation needed.
High water table; rapid seepage above a depth of 18 to 42 inches; slow seepage at greater depth. Suitable for pit-type ponds.	High water table; 18 to 42 inches of unstable organic material; fair stability and poor compaction characteristics in clayey substratum.	High water table; 18 to 42 inches of unstable organic material; fair bearing capacity, high compressibility, and low shear strength in substratum.	Severe: high water table; unstable organic material; very slow permeability within 2 to 3 feet of the surface.

Tests for liquid limit and plastic limit measure the effect of water on the consistence of a soil. As the moisture content of a clayey soil is increased from a very dry state, the material changes from semisolid to plastic. As the moisture content is further increased, the material changes from plastic to liquid. The plastic limit is the moisture content at which the soil material changes from semisolid to plastic; the liquid limit is the moisture content at which it changes from plastic to liquid. The plasticity index is the numerical difference between the liquid limit and the plastic limit. It indicates the range of moisture content within which the soil material is in a plastic condition.

The AASHO and Unified classifications given in this table are based on the mechanical analysis data and on the liquid and plastic limits.

Estimated engineering properties of the soils

Table 5 gives, for all the soils and land types in Lapeer County, information about selected soil properties that are significant in engineering. Only those soils listed in table 4 have been tested for engineering properties. Properties of the rest of the soils were estimated by making comparisons with the three soils that were sampled and tested or by working with and observing similar soils in other locations.

In general, the estimates in table 5 reflect the properties of the soils to a depth of 5 feet or less. They do not take the place of detailed onsite investigations.

Explanations of the column heads in table 5 follow. No column showing depth to bedrock is included, because all of the soils are deep enough that bedrock does not interfere with engineering operations.

Depth to seasonal high water table.—This column shows the highest level to which the water table rises in winter and early in spring. This may be either a perched water table or an ordinary ground-water table. If precipitation during the wet season has been less than average, the water table will not be so high. The short-term effects of heavy precipitation are not considered. In all soils, and particularly in sloping soils on uplands, the depth to the water table late in spring, in summer, and in fall is generally greater than the depth shown in table 5.

Depth from surface.—This column gives the upper and lower levels of the major horizons, in terms of inches below the surface. Special divisions of the major horizons are shown only if their engineering properties differ significantly from those of the rest of the horizon.

Classification.—Brief explanations of the USDA textural classification and of the two systems of engineering classification, along with references to publications in which these are explained in greater detail, are given under the heading "Engineering classification systems."

Percentage passing sieves.—The figures in these columns are estimates, rounded off to the nearest 5 percent. The percentage that passes through the No. 200 sieve approximates the amount of silt and clay particles in the soil. The larger percentages that pass through the No. 10 and No. 4 sieves include coarser particles as well as the silt and clay particles.

Permeability.—This column shows the rate at which water moves downward through undisturbed soils. The estimates are based mainly on the texture, structure, and consistence of the soil materials.

Available water capacity.—This column shows the capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil.

Reaction.—This column shows the degree of acidity or alkalinity of the soils, expressed as a range in the pH value. A pH of 7 indicates a neutral reaction; a lower pH indicates an acid reaction, and a higher pH an alkaline reaction.

Shrink-swell potential.—This column indicates the change in volume to be expected if the moisture content of the soil changes. The estimates are based mainly on the amount and kind of clay in each soil.

Engineering interpretations

Interpretations of the soil properties described in table 5 are presented in two tables: table 6, which deals with specified engineering uses, mainly highway construction, and table 7, which deals mainly with agricultural engineering. Some properties that are favorable for one engineering use are unfavorable for another. For example, a rapidly permeable substratum makes a soil unsuitable as a site for a farm pond but is a desirable property for soils on which a highway is to be located.

TABLE 6.—The column headings in table 6 are explained in the following paragraphs:

Topsoil.—This column shows the relative suitability of the soils for use as topdressing for back slopes, embankments, lawns, gardens, and the like. The ratings are based mainly on texture and organic-matter content. A high organic-matter content is a favorable characteristic. Except as otherwise indicated in the table, the ratings apply only to the surface layer of mineral soils.

Sand and gravel.—These columns relate to the presence of commercially useful sand and gravel within 5 feet of the surface. In some soils there is such material in the uppermost 5 feet and also below that depth; in other areas of these same soils, the material below a depth of 5 feet is unsuitable. Also, some soils that are rated as unsuitable do have sand and gravel at a depth of more than 5 feet. If the availability of sand and gravel is in question, test pits should be dug.

Road fill for highway subgrade.—This column gives ratings based on the performance of the soils when used as borrow for subgrade. Both the subsoil and the substratum are rated if they differ in character. Sand is the most suitable material, and clay the least suitable.

Impermeable material.—This column gives ratings based on the permeability of the soil when compacted. Examples of uses for impermeable material are linings for reservoirs and sewage lagoons and fill for embankments.

Highway location.—This column lists properties that affect the overall performance of the soils when used as locations for highways (fig. 16). The entire profile, undisturbed and without artificial drainage, was evaluated. The State Highway Department of Michigan has rated the major soils of the State with respect to their highway engineering properties (*3*).

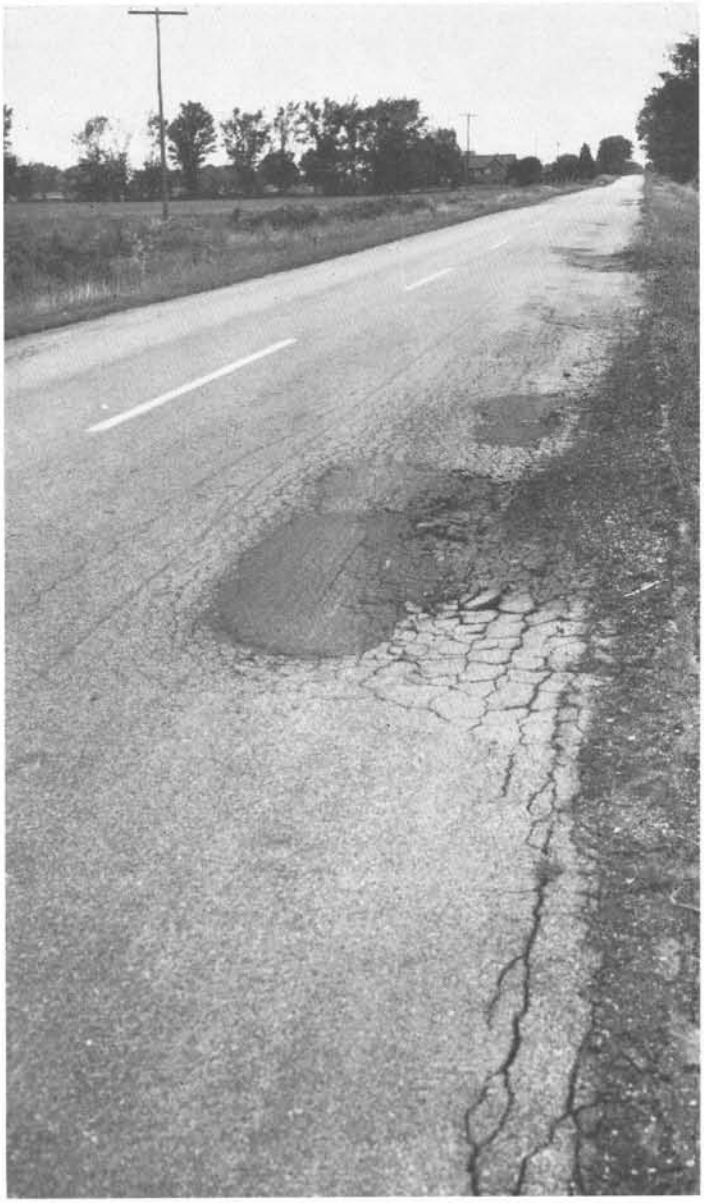

Figure 16.—**Highway on Paulding clay. The pavement is breaking up because of the high water table, inadequate bearing capacity, and other unfavorable properties of the soil. A thicker layer of subbase would have made the pavement more durable.**

Winter grading.—This column lists properties that indicate the relative ease with which the different soils can be handled and can be traversed with ordinary construction equipment during winter months. The ratings are based largely on texture, natural water content, and depth to the water table.

Corrosion potential.—These columns relate to the hazard of destruction of conduits by corrosion resulting from soil properties. Correlating the corrosion potential with any single soil property is difficult. Texture and natural drainage are significant, because they affect aeration, movement of water, and moisture content.

TABLE 7.—The column headings in table 7 are explained in the following paragraphs:

Agricultural drainage.—This column lists soil properties that should be evaluated before surface and subsurface drainage facilities are installed. Texture, permeability, topography, depth to the water table, and the presence of restricting layers are the significant properties.

Irrigation.—This column lists properties that should be evaluated before irrigation facilities are installed. Water intake rate and available water capacity are the most significant properties (fig. 17); also important are topography, depth to the water table, and depth to layers that restrict roots.

Terraces and diversions.—This column lists soil properties that affect the layout and construction of terraces and diversions. Topography, texture, and depth to layers unfavorable for crops are the significant properties.

Grassed waterways.—This column lists soil properties that affect the layout and construction of waterways and the establishment, growth, and maintenance of suitable vegetation.

Farm ponds.—These two columns list soil properties that should be evaluated before ponds are constructed. For the reservoir area, the main concerns are those properties of undisturbed soil material that affect the seepage rate; for the embankment, the properties to be considered are those that affect the suitability of disturbed soil material for use in dikes, levees, and embankments intended for impounding surface water.

Foundations for low buildings.—This column lists properties of the substratum that affect its use as the base of foundations for buildings of no more than three stories. No specific values should be inferred from the general estimates of bearing capacity.

Limitations for use as sewage-disposal field.—This column shows the relative degree of limitation of each soil and lists the limiting properties. The properties evaluated are topography, permeability (or percolation rate), depth to the water table, depth to bedrock, the flood hazard, and the risk of polluting ground water.

Soil properties that affect community development

Community development, with the accompanying extension of public utilities and establishment of business and recreational facilities, creates a need for soils information somewhat different from that needed for purposes of farming. Land appraisers, realtors, city planners, builders, and others need facts that will help them determine what sites are suitable for homes and other buildings and what areas had better be reserved for other uses. Homeowners want information that will help them in landscaping their property and protecting it against the erosion hazards of built-up communities.

Residences.—Drainage, permeability, slope, erosion hazard, stability, and frequency of flooding have to be considered in evaluating the suitability of a site for an individual home or for a subdivision.

Homes built on poorly drained soils, such as those of the Breckenridge, Brookston, Gilford, Lenawee, and Pewamo series, are likely to have wet basements unless some artificial drainage is provided. A high water table, even if only seasonal, keeps sewage-disposal systems from functioning properly. The soil descriptions

Figure 17.—Sprinkler irrigation of vegetable crops on Carlisle muck, which has a very rapid rate of water intake and a very high available water capacity. Besides promoting the growth of the crops, the additional water helps to reduce the risk of soil blowing and of frost damage.

(pages 8 to 70) give information about drainage and the occurrence of a high water table.

Permeability is another property that affects the functioning of sewage-disposal systems. If the filter field is in rapidly or very rapidly permeable soils, such as those of the Chelsea and Spinks series, unfiltered effluent may contaminate the water in shallow wells. Table 5 gives estimates of permeability rates for all the soils, and table 7 includes interpretations that show the relative limitations of the soils as locations for sewage-disposal fields.

Organic soils, such as those of the Carlisle and Houghton series, are not stable enough to be good foundations for houses. Boyer, Chelsea, and Spinks soils, which have low shrink-swell potential and fair to good bearing capacity, are examples of soils that provide good foundations. Table 5 gives estimates of shrink-swell potential for all soils, and table 7 includes interpretations on the basis of which it is possible to identify the soils that have the least serious limitations for use as foundations.

Soils on bottom lands are subject to flooding and consequently are not good choices for building sites. Ceresco, Cohoctah, Glendora, and Sloan soils are examples.

Erosion and the accumulation of sediment are serious hazards where houses are under construction. As a result of paving and of compaction of soil material, runoff from a built-up area is two to ten times as heavy as runoff from the same area while it was still in farms or forest. The runoff water concentrates in streets and gutters, instead of flowing into natural waterways, and the result is flooding and depositions of sediment in lower areas. The steeper the slope, the more severe the hazard. The sloping and steep soils of the Miami and Morley series are particularly susceptible to erosion. Table 7 includes interpretations relating to the construction of diversions and grassed waterways and the installation of drainage facilities. Measures that can be taken to control erosion in small residential tracts include the following:

1. Building driveways, walks, and fences on the contour or, if that is not possible, straight across slope.
2. Grading to make the surface level or gently sloping. The surface layer can be removed before grading and used later for topsoil.
3. Building diversions that will intercept runoff and keep it from flowing over erodible areas.
4. Constructing waterways or improving existing waterways in order to prevent gullying.
5. Draining seepage areas and waterlogged areas with tile or other facilities.

Streets, driveways, sidewalks, and patios.—Of special interest to homeowners and developers are soil properties that cause cracking and shifting of pavement. Soils high in silt, such as those of the Del Rey, Kibbie, Lenawee, and Colwood series, are subject to frost heave. Concrete placed on such soils cracks readily unless the surface of the soils is first covered with sand and gravel. Other

properties that cause pavement to crack and shift excessively are a high water table and a clayey texture. The Hoytville and Paulding soils are examples of soils that have these limitations. Pavement laid on organic soils, such as those of the Carlisle and Houghton series, is likely to crack and become uneven as a result of settling of the organic material after drainage. Table 5 gives estimates of shrink-swell potential for all the soils, and table 6 includes interpretations relating to the use of the soils for road fill and locations for highways; this information can be used to identify the soils that are unsuitable for streets, driveways, sidewalks, and patios.

Underground utility lines.—Water mains, gas pipelines, communication lines, and sewer lines that are buried in the ground may corrode and break unless protected against certain electrobiochemical reactions that result from inherent properties of the soils but differ according to the nature of the soils. All metals corrode to some degree when buried in the soils, and some metals corrode more rapidly in some soils than in others. The corrosion potential depends on physical, chemical, electrical, and biological properties of the soils—for example, oxygen concentration, concentration of anaerobic bacteria, and moisture content. Design and construction of the lines are also important. The likelihood of corrosion is intensified by connecting dissimilar metals, by burying metal structures at varying depths, and by extending pipelines through different kinds of soils. Table 6 gives the corrosion potential for untreated steel and for concrete.

If cast-iron pipe is used, stress caused by shrinking and swelling of the soils is an additional hazard. In soils that have a high shrink-swell potential, such as those of the Hoytville and Paulding series, cast-iron pipes may break unless cushioned with sandy material. Estimates of shrink-swell potential for all the soils are given in table 5.

Gardening and landscaping.—The ideal soils for yard and garden plants are those that have a deep root zone, a loamy texture, a balanced supply of plant nutrients, an adequate amount of organic matter, adequate available water capacity, good drainage, and a structure that allows free movement of water. The Miami soils closely approach this ideal. On droughty soils like those of the Boyer, Chelsea, and Spinks series, lawn grasses and shrubs dry up quickly in periods of dry weather unless they are watered frequently. Poorly drained soils, such as those of the Hoytville and Pewamo series, are difficult to work when wet and become hard and cloddy at the surface when they dry out. If such soils are disturbed by construction operations, seeding them with lawn grasses is difficult.

Other information useful in landscaping is given in the section "Use and Management of the Soils."

Public health.—Soils information has many applications to public health problems, including those of sewage disposal, trash disposal, prevention of disease, and the maintenance of a safe and adequate water supply.

Sewage lagoons, septic tank systems, and sewer lines need to be located and constructed so that seepage or drainage from them cannot pollute water supplies. One cause of pollution is leakage from sewage lagoons built on unsuitable soils, such as the rapidly permeable Montcalm and Spinks soils. Wells, streams, and lakes can become contaminated by runoff from clogged and improperly located filter fields. The soil map, which shows the major drainageways of the county, can be used as a general guide in locating filter fields where they will not cause pollution. Rapid percolation of septic tank effluent can result in pollution of shallow underground water supplies. Table 7 includes interpretations that can be used to identify the soils that should not be used as material for construction of lagoons or as locations for filter fields.

In selecting sites for sanitary land fills, it is important to consider topography, drainage, soil texture, permeability, reaction, and the nature of the underlying material. Table 5 gives estimates of pertinent properties of the soils. The soil map can be used to locate areas of suitable soils.

Stability of the soils is of major importance in selecting locations for sewer lines. If the gradeline is interrupted and the system breaks down, a public health hazard results. The shrink-swell potential of a soil (see table 5) is an indication of its relative stability. Corrosion is another cause of breakdowns in sewer lines. Estimates of the corrosion potential of all the soils are given in table 6.

Mosquitoes, fleas, and other disease-carrying insects breed in stagnant water. By the use of the soil descriptions and the soil map, it is possible to identify areas subject to flooding or ponding. Once the possible trouble spots are located, the health hazard can be controlled by spraying to eliminate insects and installing drainage systems to remove standing water.

Recreation.—Natural drainage, texture, slope, the flood hazard, and the presence of stones and cobblestones are soil properties that affect the suitability of a site for recreational uses.

Poorly drained soils that have a high water table, such as those of the Barry, Brookston, Gilford, Hoytville, and Tonkey series, have severe limitations for use as campsites, picnic areas, and intensive play areas. Carlisle and Houghton soils have especially severe limitations because of very poor drainage and the presence of unstable organic material. All of these soils, however, are suitable sites for pit-type ponds because of their high water table.

Sloping soils of the Boyer, Lapeer, Marlette, McBride, Miami, Montcalm, and Morley series have severe limitations for use as campsites and picnic areas but are suitable for paths and trails. Level to gently sloping, well-drained soils, such as those of the Boyer, Lapeer, McBride, Montcalm, and Spinks series, are fair to good for campsites, picnic areas, intensive play areas, and buildings. These soils dry out quickly and so are firm enough for foot and vehicular traffic shortly after rain.

Alluvial soils, such as those of the Cohoctah, Glendora, and Sloan series, are limited by a flood hazard.

Formation and Classification of the Soils

This section discusses the five major factors of soil formation, the processes involved in the differentiation of soil horizons, the system of classifying soils, and the placement of the soils of Lapeer County according to that system.

Factors of Soil Formation

Soil is the product of the interaction of five major factors: climate, living organisms (especially vegetation), parent material, topography, and time. Differences in any one of these factors result in the formation of a different kind of soil.

The climate of Lapeer County is cool and humid. Presumably, the present climate is similar to that which existed while the soils were forming. Since the climate is uniform throughout the county, it does not account for differences among soils. Its effects, however, are modified locally by runoff.

Plants, animals, insects, bacteria, and fungi are all important in the formation of soils. Gains in organic matter and nitrogen, gains or losses in plant nutrients, and changes in structure and porosity are among the changes these organisms bring about. Trees, both hardwood and coniferous, have affected the soils of Lapeer County more than other kinds of living organisms.

Parent material is the unconsolidated mass from which a soil forms. It determines the chemical and mineralogical composition of the soil. Except for the organic soils (peat and muck), the soils of Lapeer County formed in material deposited by glaciers. The texture of this glacier-deposited material ranges from gravel and sand to clay.

Topography, or relief, affects soil formation through its influence on drainage, erosion, plant cover, and soil temperature. Lapeer County has extremely varied relief that ranges from depressional to steep. In steep areas, local differences in relief are as much as 150 to 200 feet. Lapeer and Miami soils are common in such areas. In other parts of the county, there are large plains that have slopes of less than 2 percent. Chelsea soils occupy such areas near Columbiaville. Small level areas interspersed throughout undulating or hilly areas are wet because of runoff from nearby slopes. Depressions and some level areas are wet because of a high water table. The poorly drained Pewamo, Granby, and Colwood soils are examples of soils that formed in such locations.

Time, usually a long time, is required for the formation of distinct horizons in soils. Differences in the length of time the parent material has been in place are commonly reflected in the degree of horizon differentiation. Young soils have weakly expressed horizons; older soils have well-expressed horizons. Ceresco soils are examples of young soils; except for a darker color in the surface layer, they retain most of the characteristics of their parent material. Conover soils are examples of older soils; they have well-differentiated horizons.

Processes of Horizon Differentiation

Several processes were involved in the formation of horizons in the soils of Lapeer County. These processes are accumulation of organic matter, leaching of calcium carbonates and bases, reduction and transfer of iron, and formation and translocation of silicate clay minerals. Most of the soils have been affected by more than one of these processes.

Accumulation of organic matter in the upper part of the profile to form an A1 horizon has been important. The soils of the county range from high to very low in organic-matter content.

Leaching of carbonates and bases has taken place in nearly all of the soils. Soil scientists generally agree that leaching of bases usually precedes translocations of silicate clay minerals. Most of the soils are moderately to strongly leached.

Reduction and transfer of iron, a process called gleying, is evident in the poorly drained and very poorly drained soils. Gray colors in the subsoil indicate reduction and loss of iron. Some horizons have reddish-brown mottles and concretions, which indicate a segregation of iron.

Translocation of clay minerals, usually preceded by leaching of bases, is among the more important processes in horizon development. It results in an eluviated A2 horizon that has a platy structure and is lower in content of clay and usually lighter in color than the B horizon. The B horizon usually has an accumulation of clay (clay films) in pores and on ped surfaces. These soils were probably leached of carbonates and soluble salts to a considerable extent before translocation of silicate clay took place. Miami soils are examples of soils in which translocated silicate clay has accumulated in the B horizon.

In some soils of Lapeer County, iron and humus have moved from the surface layer to the B horizon. The color of the B horizon in such soils ranges from dark reddish brown to yellowish brown. Menominee, Iosco, and Allendale soils are examples of soils in which translocated iron and humus have affected the B horizon.

Classification of the Soils

Soils are classified so that we may more readily remember their significant characteristics, assemble knowledge about them, see their relationships to one another and to the whole environment, and develop principles that help us to understand their behavior and response to manipulation. First through classification and then through use of soil maps, we can apply our knowledge of soils to specific fields and other tracts of land.

The current system of soil classification (*4*, *7*) defines classes of soils in terms of observable or measurable properties. It is designed to accommodate all soils. The properties chosen are primarily those that result in the grouping of soils of similar genesis, or mode of origin. Genesis does not, however, appear in the definitions of the classes. This system replaces the one adopted in 1938 (*2*) and later revised (*5*).

The current system of classification has six categories. Beginning with the most inclusive, the categories are the order, the suborder, the great group, the subgroup, the family, and the series. Table 8 shows the classification of the soils of Lapeer County according to this system. Brief descriptions of each of the six categories follow.

ORDER. Ten soil orders are recognized: Entisols, Vertisols, Inceptisols, Aridisols, Mollisols, Spodosols, Alfisols, Ultisols, Oxisols, and Histosols. The properties used to differentiate orders are those that tend to give broad climatic groupings of soils. Two exceptions to this generalization are the Entisols and the Histosols, both of which occur in many different climates. Six of the ten orders are represented in Lapeer County: Entisols, Inceptisols, Alfisols, Mollisols, Spodosols, and Histosols.

TABLE 8.—*Classification of soil series by higher categories*

[As of January 1, 1970. Subject to change as more precise informaion becomes available]

Series	Family	Subgroup	Order
Abscota	Mixed, mesic	Typic Udipsamments	Entisols.
Adrian	Sandy or sandy-skeletal, euic, mesic	Terric Medisaprists	Histosols.
Alcona	Coarse-loamy, mixed, frigid	Alfic Haplorthods	Spodosols.
Algansec	Mixed, mesic	Aquic Udipsamments	Entisols.
Allendale	Sandy over clayey, mixed, frigid	Aqualfic Haplorthods	Spodosols.
Au Gres [1]	Sandy, mixed, frigid	Entic Haplaquods	Spodosols.
Barry	Fine-loamy, mixed, mesic	Typic Argiaquolls	Mollisols.
Belding	Coarse-loamy, mixed, frigid	Alfic Haplaquods	Spodosols.
Belding, clay subsoil variant	Coarse-loamy over clayey, mixed, frigid	Alfic Haplaquods	Spodolsol.
Berville	Fine-loamy, mixed, noncalcareous, mesic	Typic Argiaquolls	Mollisols.
Blount	Fine, illitic, mesic	Aeric Ochraqualfs	Alfisols.
Boyer	Coarse-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Brady	Coarse-loamy, mixed, mesic	Aquollic Hapludalfs	Alfisols.
Breckenridge	Coarse-loamy, mixed, nonacid, frigid	Mollic Haplaquepts	Inceptisols.
Brevort	Sandy over loamy, mixed, noncalcareous, frigid	Mollic Haplaquents	Entisols.
Brookston	Fine-loamy, mixed, mesic	Typic Argiaquolls	Mollisols.
Capac	Fine-loamy, mixed, frigid	Aeric Ochraqualfs	Alfisols.
Carlisle	Euic, mesic	Typic Medisaprists	Histosols.
Celina [1]	Fine, mixed, mesic	Aquic Hapludalfs	Alfisols.
Ceresco	Coarse-loamy, mixed, mesic	Aquic Fluventic Hapludolls	Mollisols.
Chelsea	Mixed, mesic	Alfic Udipsamments	Entisols.
Cohoctah [1]	Coarse-loamy, mixed, noncalcareous, mesic	Fluventic Haplaquolls	Mollisols.
Colwood	Fine-loamy, mixed, noncalcareous, mesic	Typic Haplaquolls	Mollisols.
Conover	Fine-loamy, mixed, mesic	Udollic Ochraqualfs	Alfisols.
Del Rey	Fine, illitic, mesic	Aeric Ochraqualfs	Alfisols.
Dryden	Coarse-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Edwards	Marl, euic, mesic	Linnic Medisaprists	Histosols.
Fabius	Fine-loamy over sandy or sandy-skeletal, mixed, mesic	Aquic Argiudolls	Mollisols.
Fox	Fine-loamy over sandy or sandy-skeletal, mixed, mesic	Typic Hapludalfs	Alfisols.
Gilford	Coarse-loamy, mixed, noncalcareous, mesic	Typic Haplaquolls	Mollisols.
Glendora	Mixed, mesic	Mollic Psammaquents	Entisols.
Granby	Sandy, mixed, noncalcareous, mesic	Typic Haplaquolls	Mollisols.
Greenwood	Dysic	Typic Borohemists	Histosols.
Houghton	Euic, mesic	Typic Medisaprists	Histosols.
Hoytville	Fine, illitic, mesic	Mollic Ochraqualfs	Alfisols.
Iosco	Sandy over loamy, mixed, frigid	Aqualfic Haplorthods	Spodosols.
Kibbie [1]	Fine-loamy, mixed, mesic	Aquollic Hapludalfs	Alfisols.
Lapeer	Coarse-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Lenawee	Fine, illitic, nonacid, mesic	Mollic Haplaquepts	Inceptisols.
Linwood	Loamy, euic, mesic	Terric Medisaprists	Histosols.
Locke	Coarse-loamy, mixed, mesic	Aquollic Hapludalfs	Alfisols.
Lupton	Euic	Typic Borosaprists	Histosols.
Macomb [1]	Fine-loamy, mixed, mesic	Udollic Ochraqualfs	Alfisols.
Mancelona	Sandy, mixed, frigid	Alfic Haplorthods	Spodosols.
Marlette	Fine-loamy, mixed, mesic	Glossic Hapludalfs	Alfisols.
Matherton	Fine-loamy over sandy or sandy-skeletal, mixed, mesic	Udollic Ochraqualfs	Alfisols.
McBride	Coarse-loamy, mixed, frigid	Alfic Fragiorthods	Spodosols.
Menominee	Sandy over loamy, mixed, frigid	Alfic Haplorthods	Spodosols.
Metamora	Fine-loamy, mixed, mesic	Udollic Ochraqualfs	Alfisols.
Miami	Fine-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Montcalm	Sandy, mixed, frigid	Alfic Haplorthods	Spodosols.
Morley	Fine, illitic, mesic	Typic Hapludalfs	Alfisols.
Munuscong	Coarse-loamy over clayey, mixed, nonacid, frigid	Mollic Haplaquepts	Inceptisols.
Mussey	Fine-loamy over sandy or sandy-skeletal, mixed, mesic	Typic Argiaquolls	Mollisols.
Nappanee	Fine, illitic, mesic	Aeric Ochraqualfs	Alfisols.
Oshtemo	Coarse-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Owosso	Fine-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Paulding	Very fine, illitic, nonacid, mesic	Typic Haplaquepts	Inceptisols.
Pewamo	Fine, mixed, mesic	Typic Argiaquolls	Mollisols.
Pinconning	Sandy over clayey, mixed, noncalcareous, frigid	Mollic Haplaquents	Entisols.
Richter	Coarse-loamy, mixed, frigid	Alfic Haplaquods	Spodosols.
Roselms	Very fine, illitic, mesic	Aeric Ochraqualfs	Alfisols.
St. Clair [1]	Fine, illitic, mesic	Typic Hapludalfs	Alfisols.
Sebewa	Fine-loamy over sandy or sandy-skeletal, mixed, mesic	Typic Argiaquolls	Mollisols.
Sisson	Fine-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Sloan	Fine-loamy, mixed, noncalcareous, mesic	Fluventic Haplaquolls	Mollisols.
Spalding	Dysic	Typic Borohemists	Histosols.
Spinks	Sandy, mixed, mesic	Psammentic Hapludalfs	Alfisols.
Tawas	Sandy, euic	Terric Borohemists	Histosols.
Tedrow	Mixed, mesic	Aquic Udipsamments	Entisols.

See footnote at end of table.

TABLE 8.—*Classification of soil series by higher categories*—Continued

Series	Family	Subgroup	Order
Tonkey	Coarse-loamy, mixed, nonacid, frigid	Mollic Haplaquepts	Inceptisols.
Tuscola	Fine-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Ubly	Coarse-loamy, mixed, frigid	Alfic Haplorthods	Spodosols.
Warners [1]	Fine-silty, mixed, calcareous, mesic	Typic Haplaquolls	Mollisols.
Wasepi	Coarse-loamy, mixed, mesic	Aquollic Hapludalfs	Alfisols.
Willette	Clayey, euic, mesic	Terric Medisaprists	Histosols.

[1] These soils are taxadjuncts. The reasons for excluding them from the series with which they are here identified are as follows:

Au Gres.—Chromas higher than those of Aquods, but the soils are wet unless drained.

Celina.—Clay content of argillic horizon less than 35 percent.

Cohoctah.—Dark-colored surface horizon not thick enough for a mollic epipedon.

Kibbie.—May be Udollic Ochraqualfs.

Macomb.—Chromas in subsoil higher than normal.

St. Clair.—May be Aquic Hapludalfs.

Warners.—Surface horizon of muck.

Inceptisols are most commonly on young but not recent land surfaces. In Lapeer County, some of the soils that were formerly known as Alluvial soils and some of those formerly known as Low-Humic Gley soils are classified as Inceptisols.

Alfisols have a clay-enriched B horizon that is high in base saturation.

Entisols are recent soils. They either lack genetic horizons or are only beginning to develop such horizons.

Mollisols have a dark-colored surface layer. In Lapeer County, some of the soils formerly called Alluvial soils and some of those formerly called Humic Gley soils are classified as Mollisols.

Spodosols have a B horizon enriched with iron and humus. In Lapeer County, some of the soils formerly known as Podzols are classified as Spodosols.

Histosols develop from organic material. The order includes soils formerly known as muck, peat, organic soils, and bog soils.

SUBORDER.—Each order is divided into suborders, mainly on the basis of soil characteristics that result in grouping soils according to genetic similarity. The climatic range is narrower than that of the order. The properties used are mainly those that reflect either the presence or absence of waterlogging or differences in climate or vegetation.

GREAT GROUP.—Each suborder is divided in great groups on the basis of similarity in the kind and sequence of the major horizons and in major soil properties. The horizons considered are those in which clay, iron, or humus have accumulated and those in which pans that interfere with the growth of roots and the movement of water have formed. The properties are soil temperature, chemical composition (mainly content of calcium, magnesium, sodium, and potassium), and the like.

SUBGROUP.—Each great group is divided into subgroups, one that represents the central (typic) concept of the group, and others, called intergrades, that have one or more properties of another great group, suborder, or order.

FAMILY.—Families are established within each subgroup, primarily on the basis of properties important to the growth of plants or properties significant in engineering. Texture, mineralogy, reaction, soil temperature, permeability, thickness of horizons, and consistence are among the properties considered.

SERIES.—A series is a group of soils that have horizons similar in all important characteristics, except for texture of the surface layer, and similar in arrangement in the profile. (See the section "How This Survey Was Made.")

Climate [4]

Although Lapeer County does not directly border any of the Great Lakes, its climate is modified somewhat by northeast winds off Lake Huron and by west winds off Lake Michigan. The effect of the lakes is less significant here than in the counties along the western side of the State.

Tables 9 and 10 give temperature and precipitation data based on records kept at Lapeer.

As table 9 shows, this part of Michigan experiences a wide range in temperature in the course of a year. On the average, the temperature falls to 0° F. or lower on 10 days in a winter and rises to 90° or higher on 13 days in a summer. A temperature of 100° or higher occurs in about one summer out of ten. The highest temperature of record is 105°, recorded on July 24, 1934, and the lowest is −26°, recorded on February 20, 1929. The highest monthly mean temperature of record is 79.4°, established in July 1921, and the lowest is 9°, established in January 1918. The average date of the last freezing temperature in spring is May 13, and that of the first in fall is October 7. Table 10 shows the probability of the occurrence of specified temperatures of 32° or lower in spring and fall.

More than half the annual precipitation—an average of 62 percent—falls during the 6-month period April through September (see table 10). June is the month of the heaviest average precipitation, and January the month of the lightest. About once in 2 years, as much as 1.2 inches of rain falls in 1 hour, as much as 1.4 inches in 2 hours, and as much as 2.3 inches in 24 hours. About once in 10 years, as much as 3.5 inches falls in 24 hours, and about once in 50 years, as much as 4.2 inches.

Snowfall averages 37.5 inches a year but varies considerably from year to year. Annual totals have ranged from 62.8 inches, in the 1942–43 season, to 12 inches, in

[4] By NORTON D. STROMMEN, climatologist for Michigan, National Weather Service, U.S. Department of Commerce.

TABLE 9.—*Temperature and precipitation data*

[Based on National Weather Service, Department of Commerce, records kept at Lapeer, Lapeer County, Michigan. Period of record, 1935–64]

Month	Temperature				Precipitation				
	Average daily maximum	Average daily minimum	Two years in 10 will have at least 4 days with—		Average monthly total	One year in 10 will have—		Days with snow cover	Average depth of snow on days with snow cover
			Maximum temperature equal to or higher than—	Minimum temperature equal to or higher than—		Less than—	More than—		
	°F.	°F.	°F.	°F.	Inches	Inches	Inches	Number	Inches
January	30. 2	15. 4	46	−3	1. 44	0. 5	2. 4	20	3. 8
February	31. 4	14. 3	46	−3	1. 77	. 6	3. 0	19	4. 7
March	42. 8	24. 2	64	7	1. 96	1. 1	2. 6	8	3. 4
April	56. 7	34. 1	78	22	2. 73	1. 4	4. 3	(1)	1. 3
May	69. 0	44. 4	84	31	3. 21	1. 4	4. 9	0	0
June	78. 8	53. 8	90	41	3. 46	1. 8	5. 0	0	0
July	84. 3	59. 0	94	47	2. 59	1. 2	4. 0	0	0
August	81. 5	57. 0	92	44	3. 34	2. 1	4. 2	0	0
September	74. 6	50. 9	88	35	2. 41	1. 3	3. 8	0	0
October	62. 6	40. 5	79	27	2. 35	. 6	4. 2	(1)	1. 0
November	46. 2	30. 3	64	17	1. 82	. 7	2. 7	2	2. 8
December	33. 6	19. 9	51	1	1. 50	. 7	2. 5	15	3. 5
Year	57. 6	37. 0			28. 58			64	

[1] Less than half a day.

TABLE 10.—*Probabilities of last freezing temperatures in spring and first in fall*

Probability	Date for given probability and temperature				
	16°F. or lower	20°F. or lower	24°F. or lower	28°F. or lower	32°F. or lower
Spring:					
1 year in 10 later than	April 6	April 17	April 30	May 15	May 28
2 years in 10 later than	April 1	April 12	April 25	May 10	May 23
5 years in 10 later than	March 22	April 2	April 15	April 30	May 13
Fall:					
1 year in 10 earlier than	November 12	November 2	October 18	October 3	September 21
2 years in 10 earlier than	November 17	November 7	October 23	October 8	September 26
5 years in 10 earlier than	November 28	November 18	November 3	October 19	October 7

the 1936–37 season. Measurable amounts of snow usually fall each month from November through April.

Cloudy weather is most common late in fall and early in winter. Weather Bureau records show, for December, an average of 22 cloudy days, 7 partly cloudy days, and 2 clear days. For July, the records show an average of 10 cloudy days, 13 partly cloudy days, and 8 clear days.

Precipitation during the growing season is adequate in amount and generally is well distributed. Short periods of dry weather in summer sometimes slow the growth of crops, but long periods of drought are rare. Cool temperatures, high humidity, and a preponderance of cloudy and partly cloudy days result in relatively slow evaporation and transpiration, and this along with well-distributed rainfall diminishes the hazard of drought.

The cool, moist weather that prevails during the growing season is favorable for oats, hay, and pasture. Usually the soils are moist enough in fall that seedbeds can be prepared and winter grains will germinate.

In spring, after the snow has melted, most of the soils of the county are nearly saturated. Rainfall at that time often results in runoff heavy enough to erode soils that have moderate or stronger slopes. Winds of velocities great enough to cause blowing of unprotected organic and sandy soils occur on several days each year.

Topography and Drainage

Several glaciers advanced and retreated over Lapeer County during the ice ages, the last during the late

Wisconsin glacial period, some 9,000 years or more ago. As this last ice sheet melted, rock and soil material (collectively known as glacial drift) were deposited over the entire county. The deposits range in thickness from less than 20 feet to more than 250 feet. They rest upon sedimentary bedrock, mainly shale and sandstone of the Bayport, Napoleon-Marshall, and Coldwater Formations of the Mississippian (Carboniferous) System.

Several distinctive topographic features of Lapeer County resulted from this last glaciation. Two terminal moraines were formed; these are now represented by two chains of hills, one that extends from Dryden to Hadley in the southern part of the county, and another that extends from Deanville to Columbiaville in the north-central part of the county. Till plains or ground moraines that were formed then are now represented by undulating to rolling topography, mainly in Almont, Burnside, and Elba townships. Glacial lakes once occupied areas south of Silverwood and east and north of the city of Lapeer. Large glacial channels were once present east of Lapeer, in the vicinity of Lum, and along Elm Creek east of North Branch, and smaller ones in other areas throughout the county. At one time during the glacial period, water flowed from Lake Huron westward across Lapeer County and eventually to Lake Michigan. The channel through which it flowed followed the present dry muck channel east of Imlay City, then ran northwestward along Cedar Creek to the North Branch of the Flint River and then southwestward along the Flint River into Genesee County. High sand terraces along the Flint River indicate that a considerable volume of water once flowed through this channel.

Most of Lapeer County is within the Flint River watershed. The major tributaries of the Flint River in Lapeer County are Squaw Creek, Cedar Creek, Bottom Creek, Gravel Creek, Hunters Creek, Farmers Creek, and part of Hasler Creek. Smaller watersheds in the county drain to the South Branch of the Cass River, in Burnside Township; to the North Branch of Mill Creek, in Goodland Township; and to the Belle and Clinton Rivers, in Imlay and Almont Townships.

Lakes, about 153 in number, are scattered over all but the northeastern part of the county. They range in size from a few acres to several hundred acres. Some of the largest are Nepessing, Pleasant, Elk, Barnes, Long, Hasler, Potter, and Bronson Lakes. The reservoir for the city of Flint, located on the Flint River at Columbiaville, is a prominent manmade lake.

Farm Statistics

According to the 1964 Census of Agriculture, nearly 70 percent of Lapeer County, a total of 292,795 acres, was in farms. Crops were harvested from 153,799 acres of this total, and 26,567 acres of cropland was used for pasture.

There were 2,076 farms in the county in 1964. Of these, 419 were between 1 acre and 49 acres in size, 596 between 50 and 99 acres, 775 between 100 and 259 acres, 243 between 260 and 499 acres, and 42 between 500 and 999 acres. Only one farm of more than 1,000 acres was recorded.

Of the 2,076 farms, 885 were miscellaneous or unclassified farms; 624 were dairy farms; 209 were poultry farms or livestock farms other than dairy; and the rest were vegetable, field crop, fruit and nut, and general farms.

Corn was the chief row crop grown in 1964; corn for grain was harvested from 32,535 acres, and silage corn was cut from 14,144 acres. Small grain was also grown extensively; wheat was grown on 19,523 acres, oats on 18,269 acres, barley on 325 acres, rye on 444 acres, and buckwheat on 240 acres. Soybeans were grown on 552 acres. Extensive acreages were used for hay—46,710 acres for timothy and alfalfa mixtures, 4,725 acres for clover or timothy, and 643 acres for other kinds of hay crops. Alfalfa seed and red clover seed were harvested from 1,552 acres. There were 1,101 acres of potatoes, 5,960 acres of beans, and 1,056 acres of tree fruits, nuts, and grapes. Vegetables for sale were harvested from 2,044 acres, which included 1,007 acres of carrots, 301 acres of onions, and 246 acres of lettuce; the rest was used for other vegetables.

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Glossary

Aeration, soil. The exchange of air in a soil with air from the atmosphere. The air in a well-aerated soil is similar to that in the atmosphere; that in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen than that in the atmosphere.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates such as crumbs, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alluvium. Soil material that has been deposited on land by streams.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern.

Available water capacity. The capacity of a soil to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field capacity and the amount at the wilting point. It is commonly expressed as inches of water per inch of soil.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Blinding material. Topsoil, straw, hay, sawdust, or other material placed on the sides of and over tile lines to protect alinement during backfilling and to improve permeability in the tile zone.

Board foot. The amount of wood in a board 1 foot wide, 1 foot long, and 1 inch thick; 144 cubic inches; 1/12 of a cubic foot.

Brush. Shrubs and short, scrubby trees that do not reach merchantable size.

Calcareous. Of a soil, containing enough calcium carbonate (often with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of clay on the surface of a soil aggregate. Synonyms: clay coat, clay skin.

Colluvium. Soil material, rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting either of concentrations of compounds or of soil grains cemented together. The composition of some concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are examples of material commonly found in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent; does not hold together in a mass.

Friable.—When moist, crushes easily under moderate pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart, rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard and brittle; little affected by moistening.

Contour farming. Plowing, cultivating, planting, and harvesting in rows that are at right angles to the natural direction of the slope or that are parallel to terrace grade.

Contour stripcropping. Growing crops in strips that follow the contour or are parallel to terraces or diversions. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Cover crop. A close-growing crop grown primarily to improve the soil and to protect it between periods of regular crop production; or a crop grown between trees and vines in orchards and vineyards.

Diversion, or diversion terrace. A ridge of earth, generally a terrace, that is built to divert runoff from its natural course and, thus, to protect areas downslope from the effects of such runoff.

Erosion. The wearing away of the land surface by wind (sandblast), running water, and other geological agents.

Fertility, soil. The quality of a soil that enables it to provide compounds, in adequate amounts and in proper balance, for the growth of specified plants, when other growth factors, such as light, moisture, temperature, and the physical condition of the soil, are favorable.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the oven-dry weight, after the gravitational, or free, water has been allowed to drain away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

Flood plain. Nearly level land, consisting of stream sediments, that borders a stream and is subject to flooding unless protected artificially.

Forage. Plant material that can be used as feed by domestic animals; it may be grazed or cut for hay.

Fragipan. A loamy, brittle, subsurface horizon that is very low in organic matter and clay but is rich in silt or very fine sand. The layer is seemingly cemented. When dry, it is hard or very hard and has a high bulk density in comparison with the horizon or horizons above it. When moist, the fragipan tends to rupture suddenly if pressure is applied, rather than to deform slowly. The layer is generally mottled, is slowly or very slowly permeable to water, and has few or many bleached fracture planes that form polygons. Fragipans are a few inches to several feet thick; they generally occur below the B horizon, 15 to 40 inches below the surface.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, and covered by grass for protection against erosion; used to conduct surface water away from cropland.

Green manure (agronomy). A crop grown for the purpose of being turned under in an early stage of maturity or soon after maturity for soil improvement.

Gully. A miniature valley with steep sides, cut by running water, through which water ordinarily runs only after rains. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by normal tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage. V-shaped gullies result if the material is more difficult to erode with depth; U-shape gullies result if the lower material is more easily eroded than that above it.

Habitat. The natural abode of a plant or animal; it refers to the kind of environment in which a plant or animal normally lives as opposed to its range, or geographical distribution.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. These are the major horizons:

O horizon.—The layer of organic matter on the surface of a mineral soil. This layer consists of decaying plant residues.

A horizon.—The mineral horizon at the surface or just below an O horizon. This horizon is the one in which living organisms are most active and therefore is marked by the accumulation of humus. The horizon may have lost one or more of the following: soluble salts, clay, and sesquioxides (iron and aluminum oxides).

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or some combination of these; (2) by prismatic or blocky structure; (3) by redder or stronger colors than the A horizon; or (4) by some combination of these. Combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The weathered rock material immediately beneath the solum. In most soils this material is presumed to be like that from which the overlying horizons formed. If the material is known to be different from that in the solum, a Roman numeral precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock usually underlies a C horizon but may be immediately beneath an A or B horizon.

Mottled. Irregularly marked with spots of different colors that vary in number and size. Mottling in soils usually indicates poor aeration and lack of drainage. Descriptive terms are as follows: Abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent.* The size measurements are these: *fine,* less than 5 millimeters (about 0.2 inch) in diameter along the greatest dimension; *medium,* ranging from 5 millimeters to 15 millimeters (about 0.2 to 0.6 inch) in diameter along the greatest dimension; and *coarse,* more than 15 millimeters (about 0.6 inch) in diameter along the greatest dimension.

Muck. An organic soil consisting of fairly well decomposed organic material that is relatively high in mineral content, finely divided, and dark in color.

Munsell notation. A system for designating color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with hue of 10YR, a value of 6, and a chroma of 4.

Natural soil drainage. Refers to the conditions of frequency and duration of periods of saturation or partial saturation that existed during the development of the soil, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven different classes of natural drainage are recognized.

Excessively drained soils are commonly very porous and rapidly permeable and have a low water-holding capacity.

Somewhat excessively drained soils are also very permeable and are free from mottling throughout their profile.

Well-drained soils are nearly free from mottling and are commonly of intermediate texture.

Moderately well drained soils commonly have a slowly permeable layer in or immediately beneath the solum. They have uniform color in the A and upper B horizons and have mottling in the lower B and the C horizons.

Somewhat poorly drained soils are wet for significant periods but not all of the time, and if podzolized commonly have mottlings below a depth of 6 to 16 inches, in the lower part of the A horizon and in the B and C horizons.

Poorly drained soils are wet for long periods and are light gray and generally mottled from the surface downward, although mottling may be absent or nearly so in some soils.

Very poorly drained soils are wet nearly all the time. They have a dark-gray or black surface layer and are gray or light gray, with or without mottling, in the deeper parts of the profile.

Organic soil. A general term applied to a soil or to a soil horizon that consists primarily of organic matter, such as peat soils, muck soils, and peaty soil layers.

Peat. Unconsolidated soil material, largely undecomposed organic matter, that has accumulated where there has been excess moisture.

Ped. An individual natural soil aggregate, such as a crumb, a prism, or a block, in contrast to a clod.

Permeability. The quality of a soil horizon that enables water or air to move through it. Terms used to describe permeability are as follows: *very slow, slow, moderately slow, moderate, moderately rapid, rapid,* and *very rapid.*

pH value. A numerical means for designating relatively weak acidity and alkalinity in soils. A pH value of 7.0 indicates precise neutrality; a higher value, alkalinity; and a lower value, acidity.

Plow layer. The soil ordinarily moved in tillage; equivalent to surface soil.

Profile, soil. A vertical section of the soil through all its horizons and extending into the parent material.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed as a pH value. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. Soil that tests lower than 7.0 is acid; one that tests higher is alkaline. In words, the degrees of acidity or alkalinity are expressed thus:

	pH		*pH*
Extremely acid	Below 4.5	Mildly alkaline	7.4 to 7.8
Very strongly acid	4.5 to 5.0	Moderately alkaline	7.9 to 8.4
Strongly acid	5.1 to 5.5	Strongly alkaline	8.5 to 9.0
Medium acid	5.6 to 6.0	Very strongly alkaline	9.1 and higher
Slightly acid	6.1 to 6.5		
Neutral	6.6 to 7.3		

Relief. The elevations or inequalities of a land surface, considered collectively.

Rill. A steep-sided channel resulting from accelerated erosion. A rill normally is a few inches in depth and width and is not large enough to be an obstacle to farm machinery.

Sand. As a soil separate, rock or mineral particles that range in diameter from 0.05 to 2.0 millimeters. Most sand grains consist of quartz, but sand may be of any mineral composition. As a textural class, soil that is 85 percent or more sand and not more than 10 percent clay.

Series, soil. A group of soils developed from a particular type of parent material and having genetic horizons that, except for texture of the surface layer, are similar in differentiating characteristics and in arrangement in the profile.

Silt. As a soil separate, mineral particles that range in diameter from the upper limits of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Soil. A natural, three-dimensional body on the earth's surface that supports plants and that has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief, over periods of time.

Soil separate. Any of the mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows: *Very coarse sand* (2.0 to 1.0 millimeter); *coarse sand* (1.0 to 0.5 mililmeter); *medium sand* (0.5 to 0.25 millimeter); *fine sand* (0.25 to 0.10 millimeter); *very fine sand* (0.10 to 0.05 millimeter); *silt* (0.05 to 0.002 millimeter); and *clay* (less than 0.002 millimeter). The separates recognized by the International Society of Soil Science are as follows: I (2.0 to 0.2 millimeter); II (0.2 to 0.02 millimeter); III (0.02 to 0.002 millimeter); IV (less than 0.002 millimeter).

Soil variant. A soil having properties sufficiently different from those of other known soils to suggest establishing a new soil series, but a soil of such limited known areas that creation of a new series is not believed to be justified.

Solum. The upper part of a soil profile, above the parent material, in which the processes of soil formation are active. The solum in a mature soil includes the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristic of the soil are largely confined to the solum.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular and subangular), and *granular. Structureless* soils are (1) *single grain* (each grain by itself, as in dune sand) or (2) *massive* (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. Technically, the part of the soil below the solum.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, about 5 to 8 inches in thickness. The plowed layer.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surplus runoff so that it may soak into the soil or flow slowly to a prepared outlet without causing harm. Terraces in fields are generally built so they can be farmed. Terraces intended mainly for drainage have a deep channel in which permanent sod is maintained.

Terrace (geological). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea. Stream terraces are frequently called second bottoms, as contrasted to flood plains, and are seldom subject to overflow. Marine terraces were deposited by the sea and are generally wide.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay.* The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Tilth, soil. The condition of the soil in relation to the growth of plants, especially soil structure. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable, granular structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Topsoil. A presumed fertile soil or soil material, or one that responds to fertilization, ordinarily rich in organic matter, used to topdress roadbanks, lawns, and gardens.

Water table. The highest part of the soil or underlying rock material that is wholly saturated with water. In some places an upper, or perched, water table may be separated from a lower one by a dry zone.

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GUIDE TO MAPPING UNITS

For a full description of a mapping unit, read both the description of the mapping unit and that of the soil series to which the mapping unit belongs. In referring to a capability unit or a woodland group, read the introduction to the section it is in for general information about its management. The symbol in parentheses following the capability unit symbol identifies the soil management group of the Michigan State system in which the mapping unit belongs. Other information is given in tables as follows:

Acreage and extent, table 1, p. 9.
Predicted yields, table 2, p. 82.
Suitability of soils for wildlife, table 3, p. 92.
Engineering uses of soils, tables 4, 5, 6, and 7, pp. 96 through 139.

Map symbol	Mapping unit	Described on page	Capability unit		Woodland suitability group	
			Symbol	Page	Symbol	Page
Ab	Abscota loamy sand	11	IVs-4 (L-4a)	80	O	89
Ad	Adrian muck	11	IVw-5 (M/4c)	80	J	88
AlA	Alcona sandy loam, 0 to 2 percent slopes	12	IIs-2 (3a)	74	A	87
AlB	Alcona sandy loam, 2 to 6 percent slopes	12	IIe-3 (3a)	72	A	87
AlC	Alcona sandy loam, 6 to 12 percent slopes	12	IIIe-6 (3a)	75	A	87
An	Algansee sandy loam	13	IIIw-14 (L-4c)	77	O	89
AoA	Allendale loamy sand, 0 to 2 percent slopes	13	IIIw-7 (4/1b)	76	G	88
AoB	Allendale loamy sand, 2 to 6 percent slopes	13	IIIw-7 (4/1b)	76	G	88
AsB	Au Gres loamy sand, 0 to 6 percent slopes	14	IVw-2 (5b)	79	F	88
AuA	Au Gres loamy sand, loamy substratum, 0 to 2 percent slopes	14	IVw-2 (5b)	79	F	88
Ba	Barry loam	15	IIw-6 (3c)	73	W	90
BeA	Belding sandy loam, 0 to 2 percent slopes	15	IIw-8 (3/2b)	73	G	88
BeB	Belding sandy loam, 2 to 6 percent slopes	15	IIw-8 (3/2b)	73	G	88
BfA	Belding sandy loam, clay subsoil variant, 0 to 2 percent slopes	16	IIw-8 (3/2b)	73	G	88
BfB	Belding sandy loam, clay subsoil variant, 2 to 6 percent slopes	16	IIw-8 (3/2b)	73	G	88
Bh	Berville loam	16	IIw-8 (3/2c)	73	P	89
BlA	Blount loam, 0 to 2 percent slopes	17	IIw-2 (1.5b)	72	Z	90
BlB	Blount loam, 2 to 6 percent slopes	17	IIw-3 (1.5b)	72	Z	90
BlB2	Blount loam, 2 to 6 percent slopes, moderately eroded	17	IIw-3 (1.5b)	72	Z	90
Bp	Borrow pits	17	VIIIs-1 (Sa)	81	---	--
BrA	Boyer loamy sand, 0 to 2 percent slopes	18	IIIs-3 (4a)	78	M	89
BrB	Boyer loamy sand, 2 to 6 percent slopes	18	IIIs-4 (4a)	78	M	89
BrC	Boyer loamy sand, 6 to 12 percent slopes	18	IIIe-9 (4a)	75	M	89
BrD	Boyer loamy sand, 12 to 18 percent slopes	19	IVe-9 (4a)	79	M	89
BrE	Boyer loamy sand, 18 to 25 percent slopes	19	VIe-2 (4a)	80	M	89
BrF	Boyer loamy sand, 25 to 50 percent slopes	19	VIIe-2 (4a)	81	M	89
BsA	Boyer sandy loam, 0 to 2 percent slopes	19	IIIs-3 (4a)	78	M	89
BsB	Boyer sandy loam, 2 to 6 percent slopes	19	IIIs-4 (4a)	78	M	89
BsC	Boyer sandy loam, 6 to 12 percent slopes	19	IIIe-9 (4a)	75	M	89
BsD	Boyer sandy loam, 12 to 18 percent slopes	19	IVe-9 (4a)	79	M	89
BtA	Brady loamy sand, 0 to 2 percent slopes	20	IIIw-5 (4b)	76	G	88
BtB	Brady loamy sand, 2 to 6 percent slopes	20	IIIw-5 (4b)	76	G	88
Bu	Breckenridge sandy loam	21	IIw-8 (3/2c)	73	W	90
Bv	Brevort loamy sand	21	IIIw-10 (4/2c)	77	W	90
Bw	Brookston loam	22	IIw-4 (2.5c)	73	P	89
CaA	Capac fine sandy loam, 0 to 2 percent slopes	23	IIw-4 (2.5b)	73	Z	90
CaB	Capac fine sandy loam, 2 to 6 percent slopes	23	IIw-5 (2.5b)	73	Z	90
Cc	Carlisle muck	23	IIIw-15 (Mc)	77	J	88
CeA	Celina loam, 0 to 2 percent slopes	24	I-1 (2.5a)	71	D	87
CeB	Celina loam, 2 to 6 percent slopes	24	IIe-2 (2.5a)	72	D	87
CeB2	Celina loam, 2 to 6 percent slopes, moderately eroded	24	IIe-2 (2.5a)	72	D	87
Cf	Ceresco loam	25	IIIw-12 (L-2c)	77	O	89
ChB	Chelsea loamy sand, 0 to 6 percent slopes	25	IVs-4 (5a)	80	E	88
ChC	Chelsea loamy sand, 6 to 12 percent slopes	25	VIs-1 (5a)	80	E	88
ChD	Chelsea loamy sand, 12 to 18 percent slopes	26	VIIs-1 (5a)	81	E	88
Cm	Cohoctah loam	26	IIIw-12 (L-2c)	77	O	89
Co	Colwood loam	27	IIw-4 (2.5c)	73	W	90

Map symbol	Mapping unit	Described on page	Capability unit		Woodland suitability group	
			Symbol	Page	Symbol	Page
CvA	Conover loam, 0 to 2 percent slopes	27	IIw-4 (2.5b)	73	Z	90
CvB	Conover loam, 2 to 6 percent slopes	27	IIw-5 (2.5b)	73	Z	90
DrA	Del Rey silt loam, 0 to 2 percent slopes	28	IIw-2 (1.5b)	72	Z	90
DrB	Del Rey silt loam, 2 to 6 percent slopes	28	IIw-3 (1.5b)	72	Z	90
DyA	Dryden sandy loam, 0 to 2 percent slopes	29	IIs-2 (3a)	74	U	89
DyB	Dryden sandy loam, 2 to 6 percent slopes	29	IIe-3 (3a)	72	U	89
Ed	Edwards muck	29	IVw-6 (M/mc)	80	J	88
FaA	Fabius-Wasepi sandy loams, 0 to 2 percent slopes	30	IIIw-5 (4b)	76	G	88
FaB	Fabius-Wasepi sandy loams, 2 to 6 percent slopes	30	IIIw-5 (4b)	76	G	88
FoA	Fox sandy loam, 0 to 2 percent slopes	31	IIs-2 (3a)	74	U	89
FoB	Fox sandy loam, 2 to 6 percent slopes	31	IIe-3 (3a)	72	U	89
FoC2	Fox sandy loam, 6 to 12 percent slopes, moderately eroded	31	IIIe-6 (3a)	75	U	89
Gd	Gilford sandy loam	31	IIIw-6 (4c)	76	W	90
Ge	Glendora loam	32	IIIw-14 (L-4c)	77	O	89
Gm	Granby loamy sand	32	IVw-4 (5c)	79	W	90
Gn	Granby loam	32	IVw-4 (5c)	79	W	90
Gr	Gravel pits	33	VIIIs-1 (Sa)	81	---	--
Gs	Gullied land, sandy	33	VIIs-1 (5a)	81	E	88
Gu	Gullied land, loamy	33	VIIe-2 (2.5a)	81	D	87
Ho	Houghton muck	33	IIIw-15 (Mc)	77	J	88
Ht	Hoytville silt loam	34	IIw-2 (1c)	72	P	89
Hy	Hoytville silty clay loam	35	IIw-2 (1c)	72	P	89
IoA	Iosco loamy sand, 0 to 2 percent slopes	35	IIIw-9 (4/2b)	77	G	88
KbA	Kibbie loam, 0 to 2 percent slopes	36	IIw-4 (2.5b)	73	G	88
KbB	Kibbie loam, 2 to 6 percent slopes	36	IIw-5 (2.5b)	73	G	88
LaA	Lapeer sandy loam, 0 to 2 percent slopes	36	IIs-2 (3a)	74	U	89
LaB	Lapeer sandy loam, 2 to 6 percent slopes	37	IIe-3 (3a)	72	U	89
LaB2	Lapeer sandy loam, 2 to 6 percent slopes, moderately eroded	37	IIe-3 (3a)	72	U	89
LaC	Lapeer sandy loam, 6 to 12 percent slopes	37	IIIe-6 (3a)	75	U	89
LaC2	Lapeer sandy loam, 6 to 12 percent slopes, moderately eroded	37	IIIe-6 (3a)	75	U	89
LaC3	Lapeer sandy loam, 6 to 12 percent slopes, severely eroded	37	IVe-6 (3a)	79	U	89
LaD2	Lapeer sandy loam, 12 to 18 percent slopes, moderately eroded	37	IVe-4 (3a)	78	U	89
LaD3	Lapeer sandy loam, 12 to 18 percent slopes, severely eroded	37	VIe-2 (3a)	80	U	89
LaE2	Lapeer sandy loam, 18 to 25 percent slopes, moderately eroded	38	VIe-2 (3a)	80	U	89
LaE3	Lapeer sandy loam, 18 to 25 percent slopes, severely eroded	38	VIIe-2 (3a)	81	U	89
LaF	Lapeer sandy loam, 25 to 60 percent slopes	38	VIIe-2 (3a)	81	U	89
Le	Lenawee silty clay loam	38	IIw-2 (1.5c)	72	P	89
Lm	Linwood muck	39	IIw-10 (M/3c)	74	J	88
LoA	Locke sandy loam, 0 to 2 percent slopes	39	IIw-6 (3b)	73	G	88
LoB	Locke sandy loam, 2 to 6 percent slopes	40	IIw-7 (3b)	73	G	88
Lu	Lupton muck	40	IIIw-15 (Mc)	77	J	88
MaA	Macomb sandy loam, 0 to 2 percent slopes	41	IIw-8 (3/2b)	73	G	88
MaB	Macomb sandy loam, 2 to 6 percent slopes	41	IIw-8 (3/2b)	73	G	88
Md	Made land	41	VIIIs-1 (Sa)	81	---	--
MeB	Mancelona loamy sand, moderately fine substratum, 0 to 6 percent slopes	41	IIIs-4 (4a)	78	C	87
MeC2	Mancelona loamy sand, moderately fine substratum, 6 to 12 percent slopes, moderately eroded	41	IIIe-9 (4a)	75	C	87
MfA	Marlette sandy loam, 0 to 2 percent slopes	42	I-1 (2.5a)	71	D	87
MfB	Marlette sandy loam, 2 to 6 percent slopes	42	IIe-2 (2.5a)	72	D	87

Map symbol	Mapping unit	Described on page	Capability unit		Woodland suitability group	
			Symbol	Page	Symbol	Page
CvA	Conover loam, 0 to 2 percent slopes	27	IIw-4 (2.5b)	73	Z	90
CvB	Conover loam, 2 to 6 percent slopes	27	IIw-5 (2.5b)	73	Z	90
DrA	Del Rey silt loam, 0 to 2 percent slopes	28	IIw-2 (1.5b)	72	Z	90
DrB	Del Rey silt loam, 2 to 6 percent slopes	28	IIw-3 (1.5b)	72	Z	90
DyA	Dryden sandy loam, 0 to 2 percent slopes	29	IIs-2 (3a)	74	U	89
DyB	Dryden sandy loam, 2 to 6 percent slopes	29	IIe-3 (3a)	72	U	89
Ed	Edwards muck	29	IVw-6 (M/mc)	80	J	88
FaA	Fabius-Wasepi sandy loams, 0 to 2 percent slopes	30	IIIw-5 (4b)	76	G	88
FaB	Fabius-Wasepi sandy loams, 2 to 6 percent slopes	30	IIIw-5 (4b)	76	G	88
FoA	Fox sandy loam, 0 to 2 percent slopes	31	IIs-2 (3a)	74	U	89
FoB	Fox sandy loam, 2 to 6 percent slopes	31	IIe-3 (3a)	72	U	89
FoC2	Fox sandy loam, 6 to 12 percent slopes, moderately eroded	31	IIIe-6 (3a)	75	U	89
Gd	Gilford sandy loam	31	IIIw-6 (4c)	76	W	90
Ge	Glendora loam	32	IIIw-14 (L-4c)	77	O	89
Gm	Granby loamy sand	32	IVw-4 (5c)	79	W	90
Gn	Granby loam	32	IVw-4 (5c)	79	W	90
Gr	Gravel pits	33	VIIIs-1 (Sa)	81	---	--
Gs	Gullied land, sandy	33	VIIs-1 (5a)	81	E	88
Gu	Gullied land, loamy	33	VIIe-2 (2.5a)	81	D	87
Ho	Houghton muck	33	IIIw-15 (Mc)	77	J	88
Ht	Hoytville silt loam	34	IIw-2 (1c)	72	P	89
Hy	Hoytville silty clay loam	35	IIw-2 (1c)	72	P	89
IoA	Iosco loamy sand, 0 to 2 percent slopes	35	IIIw-9 (4/2b)	77	G	88
KbA	Kibbie loam, 0 to 2 percent slopes	36	IIw-4 (2.5b)	73	G	88
KbB	Kibbie loam, 2 to 6 percent slopes	36	IIw-5 (2.5b)	73	G	88
LaA	Lapeer sandy loam, 0 to 2 percent slopes	36	IIs-2 (3a)	74	U	89
LaB	Lapeer sandy loam, 2 to 6 percent slopes	37	IIe-3 (3a)	72	U	89
LaB2	Lapeer sandy loam, 2 to 6 percent slopes, moderately eroded	37	IIe-3 (3a)	72	U	89
LaC	Lapeer sandy loam, 6 to 12 percent slopes	37	IIIe-6 (3a)	75	U	89
LaC2	Lapeer sandy loam, 6 to 12 percent slopes, moderately eroded	37	IIIe-6 (3a)	75	U	89
LaC3	Lapeer sandy loam, 6 to 12 percent slopes, severely eroded	37	IVe-6 (3a)	79	U	89
LaD2	Lapeer sandy loam, 12 to 18 percent slopes, moderately eroded	37	IVe-4 (3a)	78	U	89
LaD3	Lapeer sandy loam, 12 to 18 percent slopes, severely eroded	37	VIe-2 (3a)	80	U	89
LaE2	Lapeer sandy loam, 18 to 25 percent slopes, moderately eroded	38	VIe-2 (3a)	80	U	89
LaE3	Lapeer sandy loam, 18 to 25 percent slopes, severely eroded	38	VIIe-2 (3a)	81	U	89
LaF	Lapeer sandy loam, 25 to 60 percent slopes	38	VIIe-2 (3a)	81	U	89
Le	Lenawee silty clay loam	38	IIw-2 (1.5c)	72	P	89
Lm	Linwood muck	39	IIw-10 (M/3c)	74	J	88
LoA	Locke sandy loam, 0 to 2 percent slopes	39	IIw-6 (3b)	73	G	88
LoB	Locke sandy loam, 2 to 6 percent slopes	40	IIw-7 (3b)	73	G	88
Lu	Lupton muck	40	IIIw-15 (Mc)	77	J	88
MaA	Macomb sandy loam, 0 to 2 percent slopes	41	IIw-8 (3/2b)	73	G	88
MaB	Macomb sandy loam, 2 to 6 percent slopes	41	IIw-8 (3/2b)	73	G	88
Md	Made land	41	VIIIs-1 (Sa)	81	---	--
MeB	Mancelona loamy sand, moderately fine substratum, 0 to 6 percent slopes	41	IIIs-4 (4a)	78	C	87
MeC2	Mancelona loamy sand, moderately fine substratum, 6 to 12 percent slopes, moderately eroded	41	IIIe-9 (4a)	75	C	87
MfA	Marlette sandy loam, 0 to 2 percent slopes	42	I-1 (2.5a)	71	D	87
MfB	Marlette sandy loam, 2 to 6 percent slopes	42	IIe-2 (2.5a)	72	D	87

Map symbol	Mapping unit	Described on page	Capability unit		Woodland suitability group	
			Symbol	Page	Symbol	Page
CvA	Conover loam, 0 to 2 percent slopes	27	IIw-4 (2.5b)	73	Z	90
CvB	Conover loam, 2 to 6 percent slopes	27	IIw-5 (2.5b)	73	Z	90
DrA	Del Rey silt loam, 0 to 2 percent slopes	28	IIw-2 (1.5b)	72	Z	90
DrB	Del Rey silt loam, 2 to 6 percent slopes	28	IIw-3 (1.5b)	72	Z	90
DyA	Dryden sandy loam, 0 to 2 percent slopes	29	IIs-2 (3a)	74	U	89
DyB	Dryden sandy loam, 2 to 6 percent slopes	29	IIe-3 (3a)	72	U	89
Ed	Edwards muck	29	IVw-6 (M/mc)	80	J	88
FaA	Fabius-Wasepi sandy loams, 0 to 2 percent slopes	30	IIIw-5 (4b)	76	G	88
FaB	Fabius-Wasepi sandy loams, 2 to 6 percent slopes	30	IIIw-5 (4b)	76	G	88
FoA	Fox sandy loam, 0 to 2 percent slopes	31	IIs-2 (3a)	74	U	89
FoB	Fox sandy loam, 2 to 6 percent slopes	31	IIe-3 (3a)	72	U	89
FoC2	Fox sandy loam, 6 to 12 percent slopes, moderately eroded	31	IIIe-6 (3a)	75	U	89
Gd	Gilford sandy loam	31	IIIw-6 (4c)	76	W	90
Ge	Glendora loam	32	IIIw-14 (L-4c)	77	O	89
Gm	Granby loamy sand	32	IVw-4 (5c)	79	W	90
Gn	Granby loam	32	IVw-4 (5c)	79	W	90
Gr	Gravel pits	33	VIIIs-1 (Sa)	81	---	--
Gs	Gullied land, sandy	33	VIIs-1 (5a)	81	E	88
Gu	Gullied land, loamy	33	VIIe-2 (2.5a)	81	D	87
Ho	Houghton muck	33	IIIw-15 (Mc)	77	J	88
Ht	Hoytville silt loam	34	IIw-2 (1c)	72	P	89
Hy	Hoytville silty clay loam	35	IIw-2 (1c)	72	P	89
IoA	Iosco loamy sand, 0 to 2 percent slopes	35	IIIw-9 (4/2b)	77	G	88
KbA	Kibbie loam, 0 to 2 percent slopes	36	IIw-4 (2.5b)	73	G	88
KbB	Kibbie loam, 2 to 6 percent slopes	36	IIw-5 (2.5b)	73	G	88
LaA	Lapeer sandy loam, 0 to 2 percent slopes	36	IIs-2 (3a)	74	U	89
LaB	Lapeer sandy loam, 2 to 6 percent slopes	37	IIe-3 (3a)	72	U	89
LaB2	Lapeer sandy loam, 2 to 6 percent slopes, moderately eroded	37	IIe-3 (3a)	72	U	89
LaC	Lapeer sandy loam, 6 to 12 percent slopes	37	IIIe-6 (3a)	75	U	89
LaC2	Lapeer sandy loam, 6 to 12 percent slopes, moderately eroded	37	IIIe-6 (3a)	75	U	89
LaC3	Lapeer sandy loam, 6 to 12 percent slopes, severely eroded	37	IVe-6 (3a)	79	U	89
LaD2	Lapeer sandy loam, 12 to 18 percent slopes, moderately eroded	37	IVe-4 (3a)	78	U	89
LaD3	Lapeer sandy loam, 12 to 18 percent slopes, severely eroded	37	VIe-2 (3a)	80	U	89
LaE2	Lapeer sandy loam, 18 to 25 percent slopes, moderately eroded	38	VIe-2 (3a)	80	U	89
LaE3	Lapeer sandy loam, 18 to 25 percent slopes, severely eroded	38	VIIe-2 (3a)	81	U	89
LaF	Lapeer sandy loam, 25 to 60 percent slopes	38	VIIe-2 (3a)	81	U	89
Le	Lenawee silty clay loam	38	IIw-2 (1.5c)	72	P	89
Lm	Linwood muck	39	IIw-10 (M/3c)	74	J	88
LoA	Locke sandy loam, 0 to 2 percent slopes	39	IIw-6 (3b)	73	G	88
LoB	Locke sandy loam, 2 to 6 percent slopes	40	IIw-7 (3b)	73	G	88
Lu	Lupton muck	40	IIIw-15 (Mc)	77	J	88
MaA	Macomb sandy loam, 0 to 2 percent slopes	41	IIw-8 (3/2b)	73	G	88
MaB	Macomb sandy loam, 2 to 6 percent slopes	41	IIw-8 (3/2b)	73	G	88
Md	Made land	41	VIIIs-1 (Sa)	81	---	--
MeB	Mancelona loamy sand, moderately fine substratum, 0 to 6 percent slopes	41	IIIs-4 (4a)	78	C	87
MeC2	Mancelona loamy sand, moderately fine substratum, 6 to 12 percent slopes, moderately eroded	41	IIIe-9 (4a)	75	C	87
MfA	Marlette sandy loam, 0 to 2 percent slopes	42	I-1 (2.5a)	71	D	87
MfB	Marlette sandy loam, 2 to 6 percent slopes	42	IIe-2 (2.5a)	72	D	87

Map symbol	Mapping unit	Described on page	Capability unit		Woodland suitability group	
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MfB2	Marlette sandy loam, 2 to 6 percent slopes, moderately eroded	42	IIe-2 (2.5a)	72	D	87
MfC	Marlette sandy loam, 6 to 12 percent slopes	43	IIIe-5 (2.5a)	75	D	87
MfC2	Marlette sandy loam, 6 to 12 percent slopes, moderately eroded	43	IIIe-5 (2.5a)	75	D	87
MfC3	Marlette sandy loam, 6 to 12 percent slopes, severely eroded	43	IVe-5 (2.5a)	78	D	87
MfD2	Marlette sandy loam, 12 to 18 percent slopes, moderately eroded	43	IVe-4 (2.5a)	78	D	87
MfD3	Marlette sandy loam, 12 to 18 percent slopes, severely eroded	43	VIe-2 (2.5a)	80	D	87
MfE2	Marlette sandy loam, 18 to 25 percent slopes, moderately eroded	44	VIe-2 (2.5a)	80	D	87
MfF2	Marlette sandy loam, 25 to 60 percent slopes, moderately eroded	44	VIIe-2 (2.5a)	81	D	87
MhA	Matherton loam, 0 to 2 percent slopes	44	IIw-6 (3b)	73	G	88
MhB	Matherton loam, 2 to 6 percent slopes	44	IIw-7 (3b)	73	G	88
MkB	McBride loamy sand, 2 to 6 percent slopes	45	IIe-3 (3a)	72	A	87
MkB2	McBride loamy sand, 2 to 6 percent slopes, moderately eroded	45	IIe-3 (3a)	72	A	87
MkC2	McBride loamy sand, 6 to 12 percent slopes, moderately eroded	45	IIIe-6 (3a)	75	A	87
M1A	McBride sandy loam, 0 to 2 percent slopes	45	IIs-2 (3a)	74	A	87
M1B	McBride sandy loam, 2 to 6 percent slopes	45	IIe-3 (3a)	72	A	87
M1B2	McBride sandy loam, 2 to 6 percent slopes, moderately eroded	46	IIe-3 (3a)	72	A	87
M1C	McBride sandy loam, 6 to 12 percent slopes	46	IIIe-6 (3a)	75	A	87
M1C2	McBride sandy loam, 6 to 12 percent slopes, moderately eroded	46	IIIe-6 (3a)	75	A	87
M1C3	McBride sandy loam, 6 to 12 percent slopes, severely eroded	46	IVe-6 (3a)	79	A	87
M1D	McBride sandy loam, 12 to 18 percent slopes	46	IVe-4 (3a)	78	A	87
M1D2	McBride sandy loam, 12 to 18 percent slopes, moderately eroded	46	IVe-4 (3a)	78	A	87
M1D3	McBride sandy loam, 12 to 18 percent slopes, severely eroded	46	VIe-2 (3a)	80	A	87
M1E2	McBride sandy loam, 18 to 25 percent slopes, moderately eroded	47	VIe-2 (3a)	80	A	87
M1F	McBride sandy loam, 25 to 60 percent slopes	47	VIIe-2 (3a)	81	A	87
MmA	Menominee loamy sand, 0 to 2 percent slopes	48	IIIs-3 (4/2a)	78	C	87
MmB	Menominee loamy sand, 2 to 6 percent slopes	48	IIIs-4 (4/2a)	78	C	87
MmC	Menominee loamy sand, 6 to 12 percent slopes	48	IIIe-9 (4/2a)	75	C	87
MmD	Menominee loamy sand, 12 to 18 percent slopes	48	IVe-9 (4/2a)	79	C	87
MnA	Metamora sandy loam, 0 to 2 percent slopes	49	IIw-8 (3/2b)	73	G	88
MnB	Metamora sandy loam, 2 to 6 percent slopes	49	IIw-8 (3/2b)	73	G	88
MoB	Miami loam, 2 to 6 percent slopes	49	IIe-2 (2.5a)	72	D	87
MoB2	Miami loam, 2 to 6 percent slopes, moderately eroded	49	IIe-2 (2.5a)	72	D	87
MoC	Miami loam, 6 to 12 percent slopes	50	IIIe-5 (2.5a)	75	D	87
MoC2	Miami loam, 6 to 12 percent slopes, moderately eroded	50	IIIe-5 (2.5a)	75	D	87
MoD	Miami loam, 12 to 18 percent slopes	50	IVe-4 (2.5a)	78	D	87
MoD2	Miami loam, 12 to 18 percent slopes, moderately eroded	50	IVe-4 (2.5a)	78	D	87
MoE	Miami loam, 18 to 25 percent slopes	50	VIe-2 (2.5a)	80	D	87
MoE2	Miami loam, 18 to 25 percent slopes, moderately eroded	50	VIe-2 (2.5a)	80	D	87
MoF	Miami loam, 25 to 60 percent slopes	50	VIIe-2 (2.5a)	81	D	87
MoF2	Miami loam, 25 to 60 percent slopes, moderately eroded	51	VIIe-2 (2.5a)	81	D	87
MpC3	Miami clay loam, 6 to 12 percent slopes, severely eroded	51	IVe-5 (2.5a)	78	D	87
MpD3	Miami clay loam, 12 to 18 percent slopes, severely eroded	51	VIe-2 (2.5a)	80	D	87
MpE3	Miami clay loam, 18 to 25 percent slopes, severely eroded	51	VIIe-2 (2.5a)	81	D	87
MpF3	Miami clay loam, 25 to 60 percent slopes, severely eroded	51	VIIe-2 (2.5a)	81	D	87

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MrA	Montcalm loamy sand, 0 to 2 percent slopes	52	IIIs-3 (4a)	78	M	89
MrB	Montcalm loamy sand, 2 to 6 percent slopes	52	IIIs-4 (4a)	78	M	89
MrC	Montcalm loamy sand, 6 to 12 percent slopes	52	IIIe-9 (4a)	75	M	89
MrD	Montcalm loamy sand, 12 to 18 percent slopes	52	IVe-9 (4a)	79	M	89
MrE	Montcalm loamy sand, 18 to 25 percent slopes	52	VIe-2 (4a)	80	M	89
MrF	Montcalm loamy sand, 25 to 50 percent slopes	52	VIIe-2 (4a)	81	M	89
MsA	Montcalm sandy loam, 0 to 2 percent slopes	52	IIIs-3 (4a)	78	M	89
MsB	Montcalm sandy loam, 2 to 6 percent slopes	52	IIIs-4 (4a)	78	M	89
MtB	Morley loam, 2 to 6 percent slopes	53	IIe-1 (1.5a)	71	B	87
MtB2	Morley loam, 2 to 6 percent slopes, moderately eroded	53	IIIe-3 (1.5a)	74	B	87
MtC	Morley loam, 6 to 12 percent slopes	53	IIIe-4 (1.5a)	74	B	87
MtC2	Morley loam, 6 to 12 percent slopes, moderately eroded	53	IIIe-4 (1.5a)	74	B	87
MtD2	Morley loam, 12 to 18 percent slopes, moderately eroded	53	IVe-4 (1.5a)	78	B	87
MuC3	Morley clay loam, 6 to 12 percent slopes, severely eroded	54	IVe-5 (1.5a)	78	B	87
MuD3	Morley clay loam, 12 to 18 percent slopes, severely eroded	54	VIe-2 (1.5a)	80	B	87
MuE3	Morley clay loam, 18 to 25 percent slopes, severely eroded	54	VIIe-2 (1.5a)	81	B	87
Mv	Munuscong sandy loam	55	IIw-8 (3/1c)	73	W	90
Mw	Mussey-Gilford sandy loams	55	IIIw-6 (4c)	76	W	90
NaA	Nappanee loam, 0 to 2 percent slopes	56	IIIw-2 (1b)	76	Z	90
NaB	Nappanee loam, 2 to 6 percent slopes	56	IIIw-2 (1b)	76	Z	90
NpA	Nappanee silty clay loam, 0 to 2 percent slopes	56	IIIw-2 (1b)	76	Z	90
NpB2	Nappanee silty clay loam, 2 to 6 percent slopes, moderately eroded	56	IIIw-2 (1b)	76	Z	90
OsA	Oshtemo sandy loam, 0 to 2 percent slopes	57	IIIs-3 (4a)	78	M	89
OsB	Oshtemo sandy loam, 2 to 6 percent slopes	57	IIIs-4 (4a)	78	M	89
OsC	Oshtemo sandy loam, 6 to 12 percent slopes	57	IIIe-9 (4a)	75	M	89
OwA	Owosso sandy loam, 0 to 2 percent slopes	58	IIs-2 (3/2a)	74	U	89
OwB	Owosso sandy loam, 2 to 6 percent slopes	58	IIe-3 (3/2a)	72	U	89
OwC	Owosso sandy loam, 6 to 12 percent slopes	58	IIIe-6 (3/2a)	75	U	89
OwC2	Owosso sandy loam, 6 to 12 percent slopes, moderately eroded	59	IIIe-6 (3/2a)	75	U	89
Pa	Paulding clay	59	IIIw-1 (0c)	75	P	89
Pe	Pewamo loam	60	IIw-2 (1.5c)	72	P	89
Pm	Pewamo clay loam	60	IIw-2 (1.5c)	72	P	89
Pn	Pinconning loamy sand	60	IIIw-7 (4/1c)	76	W	90
RcA	Richter sandy loam, 0 to 2 percent slopes	61	IIw-6 (3b)	73	G	88
RcB	Richter sandy loam, 2 to 6 percent slopes	61	IIw-7 (3b)	73	G	88
RoA	Roselms clay loam, 0 to 2 percent slopes	61	IIIw-1 (0c)	75	Z	90
RoB	Roselms clay loam, 2 to 6 percent slopes	61	IIIw-1 (0b)	75	Z	90
RoB2	Roselms clay loam, 2 to 6 percent slopes, moderately eroded	62	IIIw-1 (0b)	75	Z	90
ScB2	St. Clair silty clay loam, 2 to 6 percent slopes, moderately eroded	62	IIIe-3 (1a)	74	B	87
ScC2	St. Clair silty clay loam, 6 to 12 percent slopes, moderately eroded	62	IIIe-4 (1a)	74	B	87
Se	Sebewa loam	63	IIw-6 (3c)	73	W	90
SfB	Sisson very fine sandy loam, 2 to 6 percent slopes	63	IIe-2 (2.5a)	72	U	89
SfB2	Sisson very fine sandy loam, 2 to 6 percent slopes, moderately eroded	63	IIe-2 (2.5a)	72	U	89
SfC	Sisson very fine sandy loam, 6 to 12 percent slopes	64	IIIe-5 (2.5a)	75	U	89
SfC2	Sisson very fine sandy loam, 6 to 12 percent slopes, moderately eroded	64	IIIe-5 (2.5a)	75	U	89
Sn	Sloan loam	64	IIIw-12 (L-2c)	77	O	89
So	Spalding-Greenwood peats	65	IVw-1 (Mc-a)	79	J	88
SpA	Spinks loamy sand, 0 to 2 percent slopes	65	IIIs-3 (4a)	78	E	88
SpB	Spinks loamy sand, 2 to 6 percent slopes	65	IIIs-4 (4a)	78	E	88

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SpC	Spinks loamy sand, 6 to 12 percent slopes	65	IIIe-9 (4a)	75	E	88
SpD	Spinks loamy sand, 12 to 18 percent slopes	65	IVe-9 (4a)	79	E	88
SpE	Spinks loamy sand, 18 to 25 percent slopes	66	VIe-2 (4a)	80	E	88
SpF	Spinks loamy sand, 25 to 50 percent slopes	66	VIIe-2 (4a)	81	E	88
Ta	Tawas muck	66	IVw-5 (M/4c)	80	J	88
TeA	Tedrow loamy sand, 0 to 2 percent slopes	67	IIIw-5 (4b)	76	F	88
TeB	Tedrow loamy sand, 2 to 6 percent slopes	67	IIIw-5 (4b)	76	F	88
To	Tonkey fine sandy loam	67	IIw-6 (3c)	73	W	90
TuA	Tuscola very fine sandy loam, 0 to 2 percent slopes	68	I-1 (2.5a)	71	U	89
TuB	Tuscola very fine sandy loam, 2 to 6 percent slopes	68	IIe-2 (2.5a)	72	U	89
UbA	Ubly sandy loam, 0 to 2 percent slopes	68	IIs-2 (3/2a)	74	U	89
UbB	Ubly sandy loam, 2 to 6 percent slopes	69	IIe-3 (3/2a)	72	U	89
Wb	Warners muck and marl	69	IVw-6 (M/mc)	80	J	88
WsA	Wasepi loamy sand, 0 to 2 percent slopes	69	IIIw-5 (4b)	76	G	88
WsB	Wasepi loamy sand, 2 to 6 percent slopes	70	IIIw-5 (4b)	76	G	88
Wt	Willette muck	70	IIIw-15 (M/1c)	77	J	88

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